AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 12, No. 8. WEEKLY. | NEW YORK, THURSDAY, FEBRUARY 21, 1889. | $2.50 per Annum. SINGLE COPIES 5 CENTS.

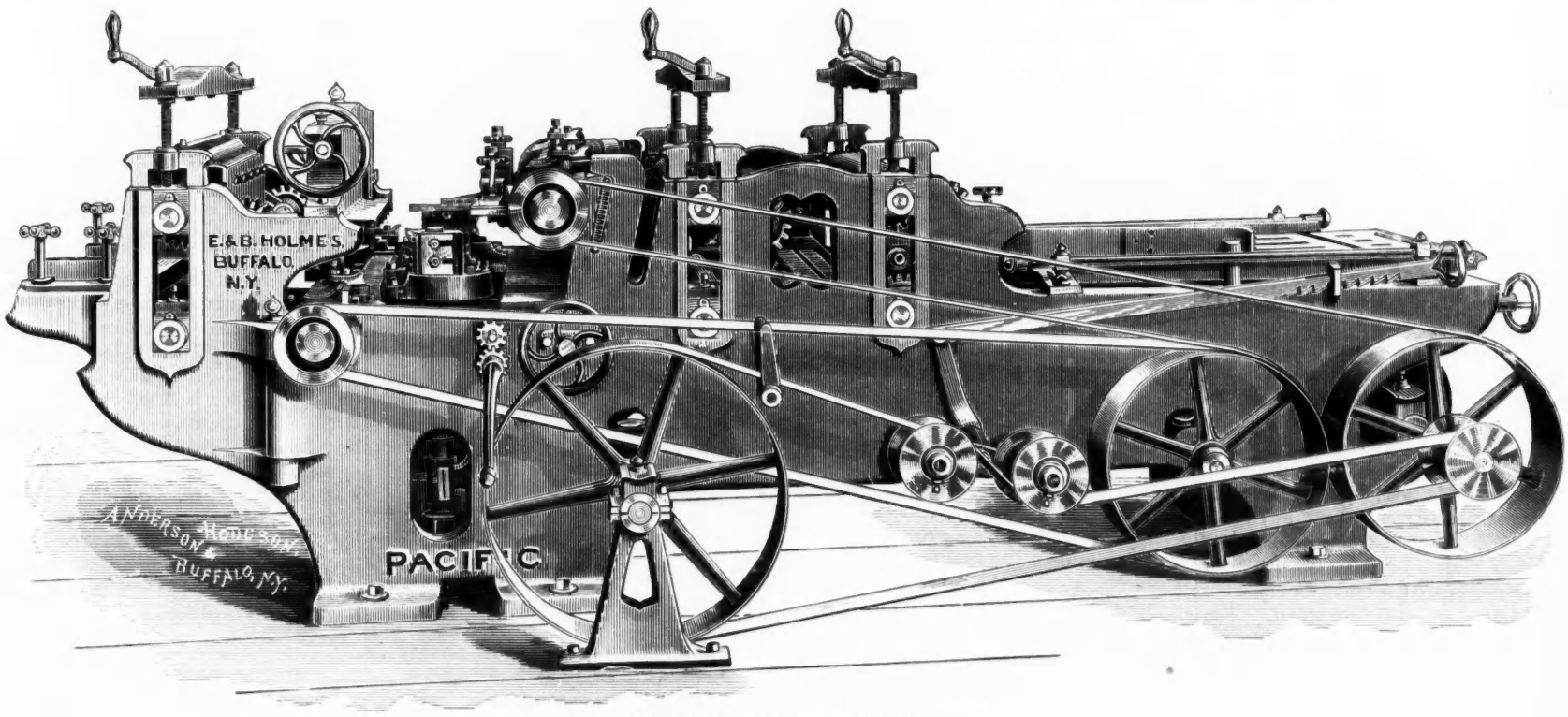
COPYRIGHT 1889, BY AMERICAN MACHINIST PUBLISHING COMPANY. For Sale Everywhere by Newsdealers. ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

A Heavy Planer and Matcher.

The accompanying illustration represents a heavy planer and matcher, recently designed and built for C. A. Hooper & Co., of San Francisco, by E. & B. Holmes, of Buffalo, N. Y. The machine was designed especially for working red-wood timber, four sides at once, up to 26″ wide, and 6½″ thick. Several new features have been introduced in its construction, among which may be mentioned the following :

The delivery rolls are placed on a swinging frame, which, by simply loosening a bolt, can be made to swing clear from the under cylinder, thereby giving the operator free access to the knives—a feature which will doubtless meet with appreciation by users of planers. The machine is also provided with Crafts' patent journal-box, and with the diagonal-ribbed pressure bar and adjustable chip breaker, which have been heretofore described in our columns.

Both matcher heads and the guide bar can be carried across the full width of the machine by simply turning one crank. There are ball bearings for raising the rolls, twenty-eight steel balls being used for each roll. The cylinders are solid crucible steel forgings, 8″ diameter, with very large bearings, and double geared. The roll shafts, countershafts, studs and pinions, are steel, and the machine throughout constructed in the best manner, and of the best materials, to stand the heavy duty for which it is intended. The machines are to be made in all sizes, from 7″ to 26″ in width, and 6½″ thick, weighing from 9,000 to 12,000 lbs., according to width.



A HEAVY PLANER AND MATCHER.

The Chinese on the Pacific coast are said to be getting about double the wages they formerly got, owing to the prohibition of Chinese immigration. At that rate John may soon come to be the best paid individual in the country.

Practical Details of Blacksmithing.

BY B. F. SPALDING.

BENDING IRON EDGEWISE—A HAND BENDER—A ROLLER BENDER—CAUSE OF SCALING—OF VARIATIONS IN LENGTH—BENDING PLOW BEAMS—LOST TIME—BENEFITS OF NEW HEATING METHODS.

One of the early jobs of my apprenticeship was to bend some rings, about 10 inches in diameter, from stock ⅜x½ inch. They were to be bent edgewise, and I found that, although it was small iron, it was not as small a job as it looked to be.

There was, if I remember aright, only one to each milling machine—some shield for a gear that was in the path of falling chips probably. As in those days there were not perhaps fifty milling machines made yearly, there were not enough of these rings needed to make it an object to construct any very elaborate machines for bending them.

It is a very slow process, to bend stock which is wide and thin, over the horn of the anvil edgewise ; for, as soon as it is struck, it wriggles into any shape but the right one, like an intractable colt. It will start to bend very well on the end if the hammer is kept firm and level ; but after enough of the circle has been formed, so that the part already bent reaches beyond the point struck by the hammer three or four inches, the trouble increases, for there is then not only a tendency for the stock to bend sidewise, but—unless it is cooled as fast as progress is made, and the blows are let fall on the cool part—there is also the tendency of inertia against the blow, which bends the straight portion, to take out a part of the bend which has already been put in. It is very convenient, therefore, to have some kind of tool to assist in the operation, even if it is nothing more than a few pins driven into a leveling block, or a segment of a circle fastened temporarily on a flat iron surface ; or where there are but a few to make at a time, but the demand constantly recurs, a simple tool like that shown in Fig. 1 (page 2) answers the purpose very well, and possesses the advantage of being always in readiness. A piece is got out for the center, which is a section of the right circle for the inside of the ring, and is a trifle thicker than the stock which is to be bent. This center is to form the inside of the ring. Two other plates are then made, which project beyond this nearly to the width of the iron, and serve as guides to keep the iron from twisting in bending. There are also two lugs fastened to this arrangement, to receive the key which keeps the stock from slipping. It is not a tool for doing the work very expeditiously, but it is much better than none, and does the work well. It is designed to be screwed into the vise. The rod, after it is made hot for what distance it is intended to bend at one heat, is put into the groove, the key is inserted to hold it, and then, by taking hold with the tongs as near as is convenient to the tool, the iron can be bent down between the guiding sides for some distance on the circular form, causing it to assume the required curve, and at another heat another portion may be bent, and so on until the full circle is made. This, after truing up sufficiently to get the exact length, is then cut off and welded, and finally trued up and leveled and perfected on a proper sized mandrel.

Where there are enough rings of this kind to warrant more expenditure for tools, they may be bent with a lever carrying a roll around a former of the right size, as shown in Fig. 2.

The base is square or of any other convenient shape to fasten to a wooden block, or it may have cast upon it lugs for the reception of set screws, with which to attach it on the top of an anvil. On this base is raised a circular piece *A*, about an inch in thickness, and a trifle—$\frac{1}{16}$ or $\frac{1}{8}$ inch—smaller than the diameter of the outside of the ring which is to be bent ; on this a circle is raised, which is of the thickness of the stock which is to be used, and of the diameter of the inner side of the finished ring. This circle is the former, around which the ring is to be bent. The lever *L* has securely fastened to it a pin on which it swings, from a hole in the center of the circle. The roll *R* is connected with the lever by a spindle on which it can revolve. Its periphery is at a distance somewhat greater than the width of the stock, from the periphery of the forming circle.

Two side views are given of Fig. 2, to illustrate different methods of keeping the stock from twisting. Fig. 3 shows how this effect is produced by means of a flange on the roll, and Fig. 5 how it is done by the bearing of the lever itself upon it, the lever being expanded in width at the proper place for this purpose. (Fig. 2 should be without this expansion if used with Fig. 3, and without the outer circle of the roll if used with Fig. 5.)

It is evident that, if a piece of hot iron is placed in this machine, and the end held by the holdfast *H*, it must conform to the shape of the circle when the lever is swung around. The action of the holdfast in gripping the stock is on the same principle as the grip which was formerly used on the Finkle & Lyon sewing machine wheel feed, and is now used on some portable forge blowers. It is made like a carriage smith's bending fork, Fig. 4. One prong being inserted in a hole provided for the purpose in the former, the handle is swung around until the other prong impinges upon and binds the stock firmly.

The circle *C* is raised as a ring, and not as a disk, because it is desirable to present little surface for the scales to abrade, as they will if they have no place to go, except to lie in wait and get jammed between the surfaces of the lever and former. The stock to be worked being heated all over, the scale which is on it is raised, even if there is no new one formed, and this is sure to come off when the

iron is bent, for it is a rather curious fact, that the scale of iron is nearly as absolutely inflexible as a cold fire brick. The whole surface of the stock scales, and therefore, on such work, provision must be made to keep it from where it can do harm.

If full circles are to be bent, it is necessary to shift the position of the holdfast, to allow the lever to be swung all the way around. Another little matter which may be mentioned is that the roller need not, and should not be so close to the former as to have the hot stock be a tight fit between them; a quarter of an inch is not too much leeway. I have seen them made so close as to sometimes pull the stock apart. If they are given a good wide clearance, they will not fail to press the stock to the former, except at the end. The too great closeness of the roll is also one cause of the variations which occur in the lengths of the rings bent from straight pieces of stock which were uniform in length; but there are also other causes. They are to be sought in some original irregularity in the size or quality of the stock, of the heat, or of something perhaps more obscure. Whenever these variations occur, it is only necessary to cut the pieces long enough to make sure that none will come too short, and then equalize the lengths by cutting off the ends after they are bent. If the object is to bend full circles, the first part that is bent must be raised off from the former when the position of the holdfast is changed, then when the lever swings around to complete the last half of the circle, it will pass under the first half, and, as soon as it has rolled off from the end of the stock, the ring is free to be lifted out on the release of the holdfast. Any length may thus be helically bent to a given circle. A slight motion or pressure on a leveling block in its heated state restores the ring to shape.

Rings can also be bent to advantage with the horizontal bending machine, and such shapes of flat iron bent edgewise, as cultivator plow beams, are fashioned by it with great facility. Thousands of them are shaped in this manner with uniformity and rapidity. A very good plan of making the shaping dies for this purpose is shown by Figs. 6 and 7. Fig. 5, the convex form, is the one to be attached to the movable crosshead, and Fig. 7, the one which remains stationary, is attached to the bed-plate of the machine. The straight stock which is to be bent in this instance has a hole punched in it at *h*, not for this purpose, but for its own completeness. It is utilized, however, in bending, to gauge from; the bent section is beyond it, and the bar is not red-hot at this point when the piece is bent. A steel pin is made fast in the die at *h*, and when the bar *A* is put on to be bent, the hole is placed over the pin, while the hot end rests against the face of the roll *R*. When the die *M* presses forward, the stock cannot slide away from the pin, and therefore, as it is forced into the recess in *F*, it is obliged to slide on the front face of *M*—shown in the broken line—and the roll *R* revolves as it moves on and away from it. The stock is kept from twisting by its confinement between the flange on *M* and the base of *F*, between which two level surfaces it is forced to keep true, although it sometimes manifests a strong tendency not to conform to its set limits, especially if of steel, and not sufficiently heated. Fig. 7 represents the strange anomaly of two pieces, *A* and *B*, occupying the same place at the same time, and the reader is requested to imagine one removed when the other is on. *B* represents the appearance of *A* after it has been bent

With the machine running six strokes a minute, 2,400 bars $1\frac{1}{2} \times \frac{9}{16}$ inch have been bent in ten hours. This was thought to be a very fair output, and it undoubtedly was. There are 600 minutes in 10 hours, and this, at 6 strokes per minute, would give the number 3,600, of which 2,400 is $\frac{2}{3}$, showing that two strokes out of three were utilized, or in Creedmoor parlance, a score of 2,400 out of a possible 3,600. What became of the extra one-third of the time? This was the question which the men who were working by the piece endeavored to solve for their own satisfaction, for the rates were fixed for the season. They figured it thus: getting the fire ready, morning and noon, one hour; slacking off, morning and noon, twenty minutes; coking up twelve times during the day, one hour; laying up the work, half an hour; loss on missed strokes, adjusting dies, repairing crooked or broken pins, one-half hour. Decency requires that persons engaged in such work as blacksmithing should devote a few moments to cleanliness before leaving the shop. The most promising method of saving a part of the lost third is in the substitution of some better fuel for coke or coal. If the fire had been on tap, instantaneously at all times, as is said to be the case when gas or the air-sprayed petroleum process is used, there could easily have been one-half of the time saved. The electric heating system is not yet far enough advanced, probably, to come in competition with these in doing such work. These

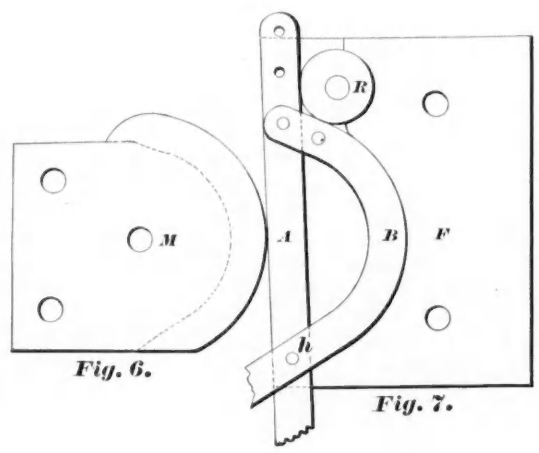


Fig. 6. *Fig. 7.*

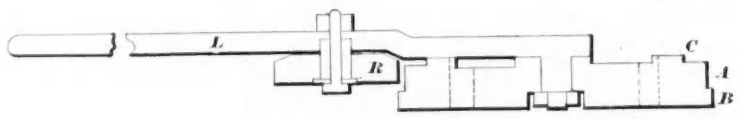


Fig. 5.

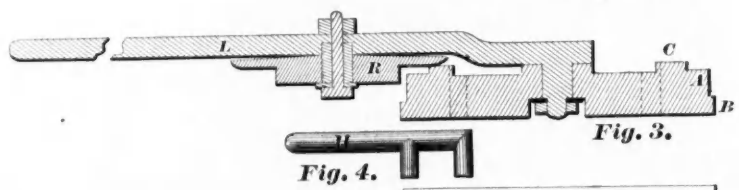


Fig. 3. *Fig. 4.*

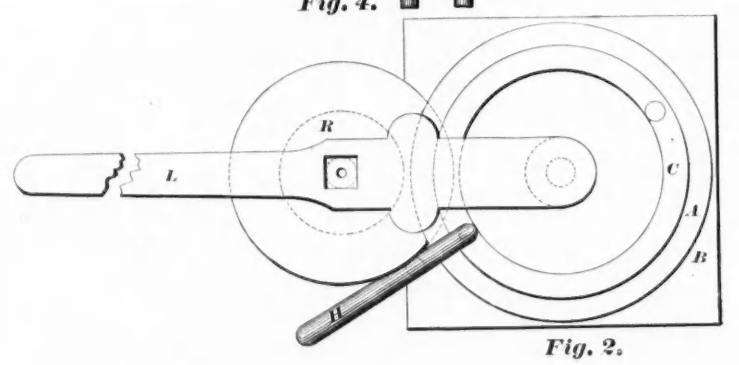


Fig. 2.

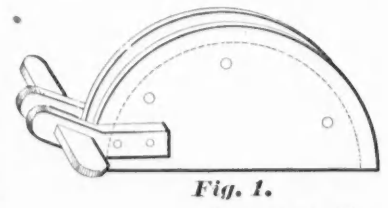


Fig. 1.

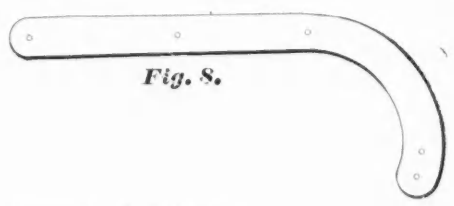


Fig. 8.

Details of Blacksmithing.—See Page 1.

2,400 pieces $1\frac{1}{2} \times \frac{9}{16}$ inch, were each put into the fire, and when brought to a white heat for a length of twelve inches, were handed to the machine tender by one heater, and there are the reasons already stated, for supposing that much more than this can be done with gas, natural, or produced from coal or petroleum, or from sprayed petroleum, at an expense which will not be greater; and with the further advantage, whatever it may be, which is to be derived from the facility with which fuel in this condition can be freed from impurities which are deleterious to the properties of iron; or can be made remedial to anything injurious which the iron itself already contains.

As a probability of there being a variation in length in circles bent edgewise has been alluded to, it may not be amiss to say here, in the nature of a counter statement, that I have known of more than 100,000 of the plow beams represented in Fig. 8 to be bent over a circle of about 10 inches after the holes were made, and the variation in length seldom exceeded one-quarter of an inch. As any variation in the width of stock creates a seemingly undue diversity in the lengths of curves, this speaks well for the uniformity of the stock.

Plain Words on the Piece-Work Question.

By Joshua Rose, M. E.

If both parties will be reasonably just, the piece-work system is the only one under which the workman can get a fair equivalent for his labor, and the employer a large quantity of good work for his pay.

Whenever you hear a workman object to the introduction of piece-work into a shop, it is on the ground that, no matter how much it may cheapen the cost of production, or how much more work the men may do, the piece-work prices will eventually be cut down until the men get no more than day wages.

Whenever you hear the introduction of piece-work into a shop opposed by those in authority, it is upon the ground that either the work might not be done as well, or else that the nature of the work will not admit of its being done by the piece.

Of these two statements, I feel bound to say that a very long experience teaches me that the first has by far the most foundation in fact. There are many exceptions—honorable exceptions—to this rule, but they *are the exceptions*, and *not the rule*.

I will refer to a case in point, of which I have intimate knowledge.

About twenty-four years ago, the proprietors of a shop of about 500 men instituted the piece-work system, selecting about a dozen of the best men, who were to give in written estimates for several jobs, such as a new set of link motions, a pair of new connecting rods, a link motion to be repaired (the exact amount of repairs being specified), etc., etc. The prices given in for the first lot of contracts averaged about 15 per cent. less than the cost by day-work, and the men made about thirty per cent. more than day wages. This was done by dint of sheer hard work, and it was a sight to see the piece-work men with their shirt sleeves rolled up and their shirt collars and neckties taken off, in the depth of winter, in a shop with no fires or heat of any kind in it. In the course of about three months, however, the day-work prices had been cut down about thirty per cent. by the piece-workers, and yet the latter were making about 50 per cent. more than day wages, and in some cases nearer 60 per cent. more. There was a rule made, that, if a piece-worker made more than 50 per cent. more than day-work wages, his prices were to be cut. As a rule, this could be done by asking other men to compete for the job, and this generally succeeded; but there was one man who cut the day-work prices down about 50 per cent., and still earned about 70 per cent. more than day pay, and none of the men could take the work at his prices, and, as a result, he was badgered by the foreman to voluntarily reduce his prices, and either had to do so or be in a perpetual warfare with his employers. This went on for several years, and he finally left the works in disgust. Now, it is an actual fact, that that man would take a set of castings, forgings, etc., for an engine, and do them for about half the price of another piece-worker (who would take the same job from the same heaps), and yet earn about ten per cent. more money, with the result that, on account of earning more than "time and a half," he was continually grumbled at, and asked (nay, tried to be forced) to reduce his prices, while the other man gave perfect satisfaction at double the price, simply because he did not earn more than "time and a half."

Last year I visited this same shop, and found that the piece-work system had been introduced throughout the works, but the result of the cutting of prices, that had been systematically pursued, was that the men were working at a day-work rate, and to look at them one would never dream that they were working piece-work.

Upon speaking to some of them about this matter, they were candid enough, telling me that prices had been cut and cut, until a man could not earn enough over day wages to make it worth while to work so hard, and they had improved their methods so much that they could jog along easy at the piece-work prices, and managed it so as to earn about fifty cents a week more than day pay, which satisfied all hands, and in reality got rid of the piece-work difficulty. Being thoroughly familiar with every detail of the work done in that shop, I will undertake to say, that under a just and proper piece-work system, each man could have nearly doubled his amount of work.

In a large shop in Providence, R. I. (this shop is now closed, I believe), there were about 80 men on one floor, and I remember in 1877 saying to the superintendent as I passed through, "There is only one man working piece-work on this floor, and that is the man" (pointing to him), and it was so.

On another occasion I visited a very large works indeed, where the piece-work system is supposed to have reached a high degree of perfection and to extend to very minute details, and I will undertake to say that, if the authorities of that works will fix the prices for two years, at the end of that time they will open their eyes and reduce the present prices 25 per cent. with the cordial consent of the men, most of whom will have profited considerably by the two years of fixed prices. In my own mind I think that fixing the prices once a year would answer, and certain it is that fixed prices for a given time, no matter what the workman earned during the year, is the secret of successful piece-work.

By *successful piece-work* I mean a system, by means of which the *cost of the work continues to reduce year after year*, while the workman's *wages increase year after year*. A former general foreman of the Susquehanna Railway Works once said to me as follows: "If I had power to let all work piece-work, at prices fixed for a year at a time, I could save thousands of dollars," and this is my own experience.

There are hundreds of good men who do not believe in piece-work, who cannot see how, on their particular work, a man is going to make anything by piece-work, and yet reduce the cost. There was a time in my life

when I was of that way of thinking, and if anybody had told me that I could have taken the work at prices I afterwards did (making from $10 to $12 a day), I should have thought him a fit subject for a lunatic asylum.

How is this done? Well, by giving the man a sufficient monetary interest in his work to cause him to not only put forth his whole muscular power, but to also study his work and improve its methods; to keep his tools in order and make new ones, at his own cost if necessary. No man will do this, if he finds from experience that any improvement he may make, and that may expedite his work, is to be used to cut his prices and keep his rate of pay stationary.

As to the quality of piece-work, it will always be better, in proportion to what the workman has at stake. No man would be fool enough to risk losing a job at which he earned even $5 a day only, by being put back to day-work, because he scamped his piece-work. Or, again, it is easy enough to inspect the piece-work, or else appoint one of the day workmen to do it, and there is not much fear but that he will find all the fault he can.

On a visit to a shop in Paterson, N. J., in which shop I was acquainted with the piece-work system, I was told, "We get this job done for quite a third less than we used to pay," and I will tell you how that was done. First, by cutting down the piece-work price a third, next by the introduction of a labor-saving device, and third by the employment of inferior skilled labor. Now, in the first place, the floor space occupied for this job had been very nearly doubled. In the second place, they did not work piece-work, they worked at a day-work rate and called it piece-work, and one of them said to me, "You see, sir, it's a nice way to work day-work under another name. I can come in a few minutes late, take a rest when I like, loaf if I like, and so on, and they are satisfied because I'm working piece-work, or supposed to be."

I made up my mind, years ago, that it was an utter impossibility to get more than a fair equivalent either for your money or your labor, in the long run, and I see this more and more every day; and the man who secretly congratulates himself at the idea that he is getting the best of it, unknown to his employers, that man, I say, is on the wrong track, and will surely come to grief.

So also the employer that thinks he has got his men working piece-work at about, or very little more, than day pay, is in a fool's paradise, and is being completely fooled.

Drilling Machine—Link Milling Machine.

With this we illustrate two new tools recently brought out by Pedrick & Ayer, Philadelphia, Pa., both being the invention of Mr. P. Leeds, master mechanic Louisville & Nashville R. R.

Fig. 1 is an attachment for the drill press, and is so made as to bolt to the table of the machine, and be driven direct from the drill press spindle by means of either of the two taper shanks shown. By either of these shanks the spindle shown at the right is driven, and this spindle can be set at any desired angle by loosening the four nuts shown in the circular plate to which the spindle is attached. Drilling in all directions can be done, and it is useful in drilling the ends and diagonal parts of frames, or it can be mounted on the work and driven by a sliding shaft and universal joints. The machine is adapted to replace a good deal of expensive ratchet work, and is capable of drilling with as great speed as though the drill were in the drill spindle itself.

Fig. 2 is a machine also adapted to be used on the drill press as shown, or on the milling machine, and is for milling out locomotive and other valve motion links to any desired radius. It is designed upon the principle that the vertex of any angle will touch or describe all parts of an arc whose height is equal to the altitude of a triangle whose base is the chord of the arc. It consists of two plates jointed together in the middle and having upon their upper surfaces dovetailed slots, in which fit two blocks which are attached to, and can swivel upon the bottom of a frame into which the link is secured. To one of these blocks the traversing screw is attached. When traversed by this screw, a curve will be milled the radius of which will depend upon the angle to which the two slides are set with each other and this angle can be adjusted to the desired radius. In the center of the joint, about which the two parts turn is a bronze bushing, which is set exactly under the center of the spindle. This bushing serves as a support for a boring bar, or for an extension of the cutter arbor. In practice it is found most convenient to drill a hole in one end of the link, large enough for a boring bar to pass through, and then to use a double-ended cutter large enough to remove most of the stock by feeding vertically down through the link, advancing it $\frac{3}{8}$" or $\frac{1}{2}$" at each cut, after which a milling cutter similar to the one shown is used to finish the job. With this attachment a link 20" long is finished in about four hours, and in a very superior manner.

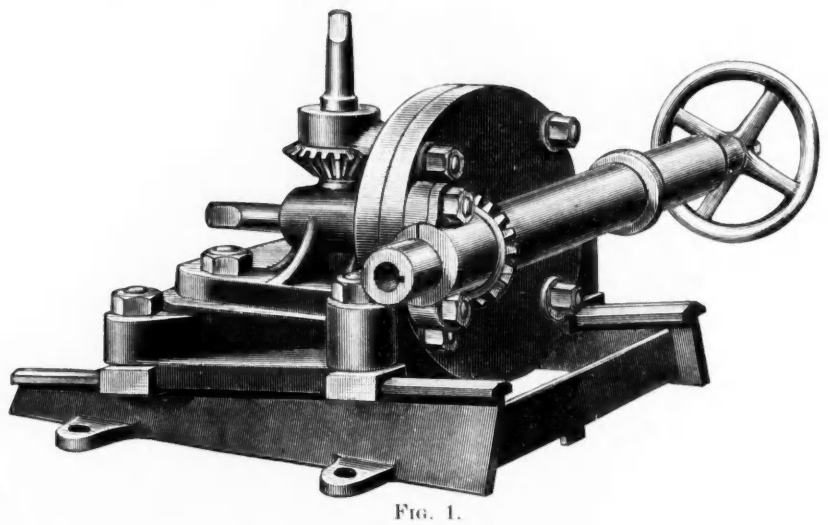


FIG. 1.

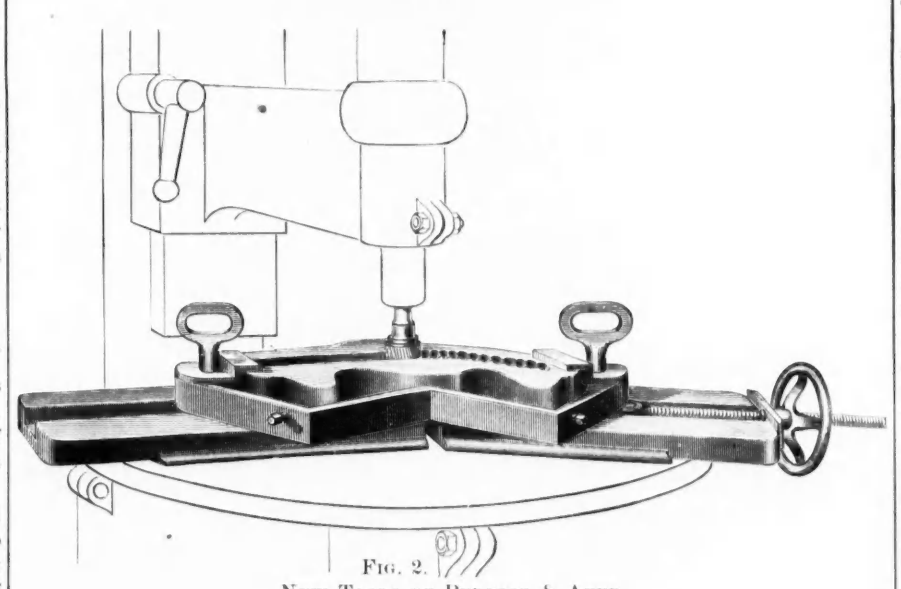


FIG. 2.

NEW TOOLS BY PEDRICK & AYER.

A daily paper, in speaking of the bursting of a centrifugal drying machine that let go, doing considerable damage, gravely assures its readers that all at once, "without warning," the catastrophe occurred. Of course, such machines usually advertise the date upon which they will fail to hold together.

The Massachusetts Institute of Technology.

The following extracts which we make from a private letter from one of the students, show a very pardonable pride in the affairs of this Institute:

I will show by a few statistics that the Institute continues to prosper. (N. B.: The "machine" which compiled these statistics has never been known to "slip an eccentric," and it may be added is not run by a "crank," so the statements can be taken as fairly reliable.)

The Freshman Class (Class of '92) numbered 330.

The whole number of students is 898.

One new course—Chemical Engineering—has been added.

The present number of professors and instructors is eighty-six.

The Institute has received $200,000 from the State—one-half of which goes for scholarships, however—and nearly or quite as much more from private sources.

A summer school of mining has been started, improvements in several courses have been made, and considerable apparatus added.

But the best of all is that we are to have a new five-story brick building. It is to be built this spring and summer, and will make four buildings that will be occupied by Tech, besides the gymnasium and the room taken in the art museum. The new building is to be for the exclusive use of the "mechanicals" and "civils." It will greatly relieve the present crowded quarters of the Institute.

I also understand that the mechanical department is to have a 150 horse-power triple expansion engine added to its laboratory for experimental purposes.

At some future time I will give you a description of our mechanical engineering laboratory, and also of the shops . . . We have quite an extensive series of shops supplied with modern tools.

Shop Notes.

E. C. Stearns & Co., of Syracuse, N. Y., make various hardware and kindred articles, and have in their machine shop a number of ingenious and effective machines and tools for performing the various operations on such work, though perhaps the most notable point about their establishment is the perfection attained in the making of castings in such a manner as to obviate so far as possible the need of any machinery or tools, either special or standard, in finishing them. Articles of hardware are made consisting of several pieces, cast and put together as they come from the cleaning room, many of them being of such a nature that one would scarcely believe that the parts could be cast with sufficient accuracy to go together and work as they do without any fitting being done upon them. One of the articles so made is a swiveled sheave pulley, which is grooved for a rope to run over, and is hung in a frame which is suspended by a swiveled hook. It is intended principally for farmers' use about barns, etc., and is made entirely of cast-iron, including the hook (which has a ball at its lower end, which is cast in the socket to make a universal joint), and the pin upon which the pulley turns. No fitting whatever is done upon any of the parts, and yet it must be conceded that it is a very creditable piece of work, and particularly when it is considered simply as a product of the foundry. The method employed in moulding the pulleys used in them is particularly ingenious.

It is a webbed pulley, and is without projections of any kind, the pattern being so made that its entire surface can be finished in the lathe. After so finishing them, the pattern is divided into two parts; but instead of cutting it through the center on a line which is at right angles to the axis, as is usually done with such patterns, it is divided the other way, parallel to the axis, or so that the hub is cut through its center lengthwise instead of across it. A hole having previously been bored through the hub, of the proper size for the core print, several of these halves of the pattern are fastened side by side and at suitable distances from each other, to a steel shaft having a small hand crank at one end. A box is provided, equal in width and length to the flask, the top of this box being covered over with a thin plate of iron.

The shaft is journaled at each end of the plate, and passes through the center of it at such a height that just one-half the shaft shows above the plate. Now, when the crank handle is in the proper position, the several halves of the pattern are all above the plate, in which openings are cut which are the exact shape of a section of the wheel upon the line at which the pattern has been divided, so that, by turning the crank just half a revolution, the patterns, all turning with it, pass through these openings, and are thus brought below the plate.

While the crank is in the first position, and the patterns all above the plate, one-half the flask is placed over them and rammed up. Then the crank is turned half a revolution, which draws the patterns by turning them through the sand, the plate, which closely fits the pattern at all points, preventing its displacement. The other half of the mould is made in the same way, suitable dowel-pins ensuring their exact matching.

The prints left by the revolving shaft serve as core prints, and the operation, besides being remarkably expeditious, produces a very accurate and true casting.

Another interesting operation is the casting of flues for heating-furnaces, a great many of which are made here.

These flues consist of pipes 6" diameter, and cast in a complete circle or ring $3\frac{1}{2}$ feet diameter. There is only one opening in them of any considerable size, that is at one side, and about six or eight inches long, and half as wide. The core can be supported at three points only, and must be rigid enough to keep its place, yielding enough to allow for shrinkage after the mould is poured, and finally must be capable of being taken out at the opening named. Mr. Featherstone, the foreman of the foundry, solved this problem by making a ring in short sections or segments, which lap over each other and are keyed together to form a complete ring of the proper diameter.

These segments are about square in section, hollow, and perforated with numerous small holes.

The faces of the different sections fit together in such a way that the complete ring is quite sufficiently rigid laterally, which is the direction in which it must support its weight; but it can yield the other way, *i. e.*, in its diameter, by the pressure caused by shrinkage.

By means of a suitable circular core-box, this ring is placed in the center of a sand core, and, when the casting is cooled, is taken out of the opening a section at a time by knocking out the keys which hold them together.

These are a few only of the many ingenious devices and plans followed in a foundry where the art of moulding, especially of small pieces in large numbers, seems to have been developed near to the point of perfection.

At Sweet, Barnes & Co's. establishment, they make cutter bars and knives for reapers and mowers. Some years ago Prof. John E. Sweet was superintendent of the place, and on the press which cuts out the steel "sec-

tions" which form the knives, is to be seen his device for counting the number of sections punched. It is attached to the slide, and consists of a ratchet wheel, a tooth of which engages with a pin as the slide descends and turns it one notch; this motion is transmitted and reduced by worms and worm gearing, after the manner of revolution counters, so that a great number are counted and indicated by pointers before it is necessary to reset it. The pin which engages with the ratchet wheel is movable, and, when left to itself, springs back sufficiently to escape the wheel. It is brought into position so that it engages with the wheel by bringing the steel to be punched fairly up against the gauge, and unless this is done the section will be spoiled and will not be counted. The lower end of the lever to which the pin is attached reaches down beside the gauge, and must be shoved back slightly by the steel before the latter can come into contact with the gauge, and, by shoving this back, the pin which is at the upper end of the lever is thrown in sufficiently to engage the ratchet wheel, and turn it one notch as the slide descends.

Among the other notable features is a furnace designed by the present superintendent for tempering these sections. They are previously hardened along the edges in a lead bath, the furnace being simply for the purpose of drawing the temper. They are put into an iron tumbling barrel, which rests in bearings without caps, and made hollow so that a stream of cold water can be kept running through them. The barrel is kept revolving by power, and is enclosed in a furnace in such a way that the heat from the fire can be directed around it. In this way the sections are drawn to an exactly uniform temper, and in very large numbers at one charging of the barrel, which enables the heat to be applied slowly, as it should be. No sand or anything else is put in with the sections, and the furnace is so constructed that, by opening a door at one side after the heat has been shut off, a slab can be taken off the tumbling barrel, and the sections allowed to fall into an iron box or barrow placed to receive them. The journals upon which the barrel turns are quite large, and one of them has a hole through it into the interior, kept closed by a suitable stopper, which can be removed, and a small paddle-shaped iron introduced. A section soon falls upon this and can be drawn out for examination as to the progress of the drawing, and put back without stopping the motion of the barrel. After finishing, the sections are riveted to the knife backs in an ordinary punch press which upsets two rivets at each stroke, a fork which presses the sections firmly to the back being brought down upon them by a lever which is moved by a cam on the shaft of the press.

Chilled Castings.

BY S. BOLLAND.

Chilled castings ought to combine the maximum of strength with a hard wearing face. To insure these conditions, especially in car wheels, the tread or outer surface of the rim should be chilled to whiteness, passing into a mottled iron, and from that to a soft grey in the interior of the wheel.

The irons used for these castings are certain brands of cold blast charcoal, brown hematite or specular iron; few, if any of the pure magnetites can be used successfully for the purpose. Especially is this the case with most of the No. 1 irons, which usually contain an excess of carbon in the uncombined state.

At the same time, it is, we think, impossible to predetermine from the chemical analysis of any pig-iron, whether it will produce good chilled castings or otherwise.

It must be admitted that certain mixtures of pig-iron will answer better than others, but what these mixtures are exactly, can only be ascertained by such founders as make the manufacture of chilled castings a specialty.

An article published in the AMERICAN MACHINIST, July 10, 1886, entitled "Mixtures for Rolls," discusses the various difficulties which beset the founder when he essays to establish formulas, or mixtures which shall be considered as standard; and, when in addition to what is therein stated, we consider that a difference in the mode of working in the blast furnace may change the nature of a metal which had previously given satisfaction, so as to render it absolutely worthless, we realize the imperative necessity of constant daily tests of the mixtures in use; such tests to be made at least one day prior to the cast. There is no doubt but that the mixing of the iron for chilled work is the most important as well as the most difficult part of the business.

The most that can be done by the founder who is entering upon this line of work, is to select irons which contain a considerable portion of their carbon in a combined state, and which yield a strong, tough, fine-grained, bright grey, also such as exhibit a grey mottled fracture in the pig.

Spiegeleisen, in proper quantities, can be added to the mixture, if found too soft and too low in chill.

Certain proportions of Bessemer steel scrap will impart strength as well as deepen the chill. Some say that, by using Bessemer steel, charcoal iron may be dispensed with altogether; but I have failed to elicit confirmation of this when the question was put to an eminent specialist, who said that, after repeated trials of mixtures composed of steel scrap in varying proportions with the best brands of anthracite pig, he had failed to produce a mixture which would meet every requirement, and consequently had continued the use of charcoal pig exclusively.

Old car wheels, which have been made by a reliable firm, may be mixed in proportions varying according to the grade of metal they are composed of, and the depth of chill; in fact, such wheels, when the fracture shows a low percentage of mottle, with but a very thin film of chilled surface, are, in some instances, the best mixture that can be obtained.

When iron of the exact grade and quality needed cannot be obtained, recourse must be had to a judicious mixing together of white irons with some of the dark grey irons, the proportions of which can be ascertained only by practice and keen observation.

There are many excellent brands of charcoal iron in use for the manufacture of chilled castings, but none of them exceed in quality, or produce better results than the "Salisbury." This conclusion is arrived at after careful and studious experimenting on my part, backed by the opinions of some of the leading manufacturers in the States.

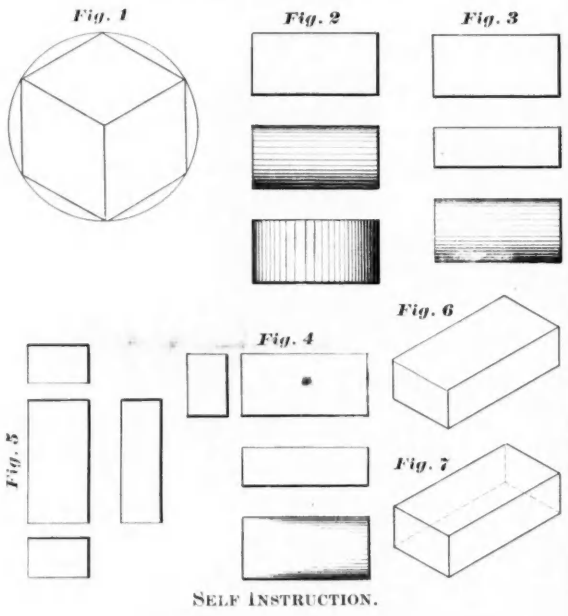
Self-Instruction for Young Mechanics.

BY FRANK RICHARDS.

IV.

One would only be betraying himself to express anything but high appreciation of Mr. Meyer's valuable instructions in mechanical drawing. Those who have followed his course thus far must feel that they are getting their reward in the interesting work he is now leading them into. It would seem that a good graduated course of examples in free-hand drawing, embracing subjects that occur in the machine shop, would be of value. But probably, if such examples were given, the first use they would be put to would be a misuse of them. A servile copying of them would certainly do no good. I have known a great many hard-earned dollars—and that is the only kind of dollars that I know anything about—paid out for so-called instruction in free-hand drawing, the "instruction" consisting in placing before the scholar a picture to be copied, with a word of praise or censure over the result, and then another one to copy, and so on as long as money and patience lasted, and after all the victim no better able to draw a thing than at the beginning. Of free-hand drawing it is especially true that it can only be learned by actually doing the real thing. It is practically only of value in doing original work. Copying pictures, as I say, is waste of time. Drawing from models is original work, and is always good practice, and is valuable in results in the proportion in which correctness and facility are attained. One should at least be able to draw at sight any simple thing that can come before him. If one cannot draw a thing that he has in bodily shape before him, he is doubly unable to draw what he has only in his mind's eye, and so, as a designer or inventor, he is helpless indeed. In sketching, the reproduction of minute or intricate details is not to be expected, nor is it necessary.

The eye and the hand of the novice require diligent practice and extensive training, and while I cannot think that any facility in drawing is to be acquired by copying pictures, as such, there are many elementary exercises that are profitable. For instance, it will take a great deal of practice to get a young fellow so that he can put a simple straight line upon paper, just where it should be,and as it should be in all particulars—horizontal, vertical, or in any desired direction, and as accurately as possible to a required length. Then one has to judge of angles correctly, and produce them, then circles of various sizes and in different positions and relations to other parts of an object, then curved and irregular lines of all kinds occur, and to be able to produce them all will require long and faithful exercise of eye and hand, and, above all, patience.



SELF INSTRUCTION.

And here comes to me a nice little question of grammar. I don't know whether, in the sentence above, I succeed in making exercise to apply to patience as well as to eye and hand, or not, but I mean it to so apply. One's stock of patience is not, as many seem to think, a fixed quantity, but it can be cultivated and will grow under cultivation, and will pay for cultivation as much as any other element of skill. And when I say that a young mechanic should study but one thing at a time, that is to be accepted with such qualifications as common sense will be able to apply. It obviously does not rigidly apply to sketching or free-hand drawing. Drawing is not taken up, as the text books of science are, to be studied until we get through them, and then dropped. We don't get through drawing. It is to be practiced always after once beginning, and so it can be worked in between everything else, whenever and wherever opportunities open. If we can think of all our drawing as practice work, and ourselves as always in training, the training that real life thus gives may soon drive out the elementary work. One can't be blamed much for tiring of elementary practice. We need the encouragement of actual progress; we would all rather be marching than "marking time."

I suppose it is from constantly seeing working drawings of machinery, and no other representations of it, that mechanics generally are entirely unable to sketch anything in perspective. Yet, in perspective or pictorial work is where free-hand drawing is most valuable to the mechanic. Without perspective or without some representation of more than one side of an object, a drawing is not readily and effectively descriptive to the untrained eye. It seems to me that if mechanics could get hold of the simple principles of isometric projection, it would help them much in making intelligible sketches of machinery. The mechanical draftsman does not use it very commonly, and I suppose the principal reason is the difficulty of drawing ellipses. The mechanical draftsman does not like them at all, and no one seems to get up a good instrument that will readily and correctly draw ellipses *in ink*, and so help him out of his trouble. But this objection does not apply to free-hand drawing at all, because it is just as easy to draw an ellipse by hand as it is a circle, and perhaps a little easier. So I think that I will be doing a good service if I venture to explain the principles of isometric projection, so that common folks will not be afraid to use it every day, if they choose to. No one will think that I am trying to set myself up for a professor of drawing on account of it.

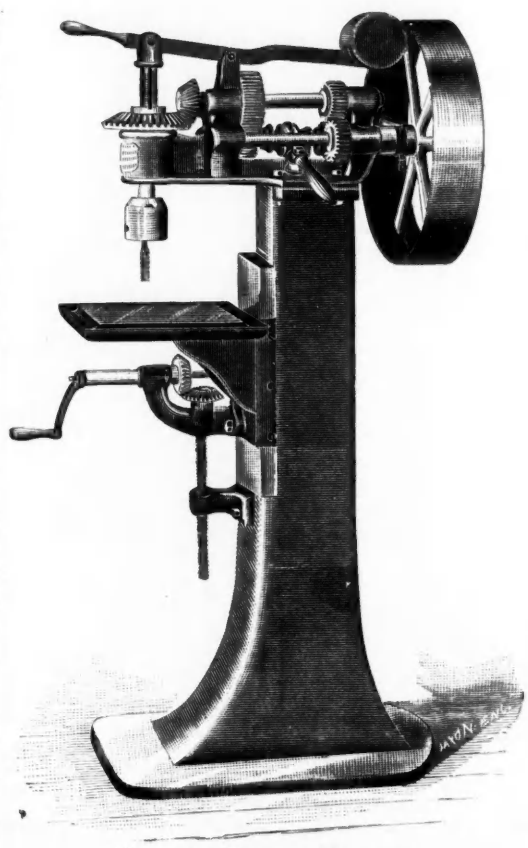
The regulation way of teaching the principles of isometric projection is by the drawing of a cube (Fig. 1). That is supposed to show the whole thing. Of course it does; but why not use a brick,that shows it better? Even the word cube is objectionable, because it is one of the words that frighten the poor little machinist. If you want to teach a confiding and unsophisticated machinist about isometric projection, don't say cube to him. It will make him prick up his ears and distend his nostrils, as though he sniffed danger in the air. You might think a cube was coming right at his head, full speed and cornerwise. A brick wouldn't frighten him nearly as much. He is tolerably familiar with a brick, and, above all things, he detests the unfamiliar. A brick is handy for illustrating many things. Hunt up Chordal's letters, and learn the principles of friction from a brick. We haven't learned a thing very thoroughly, and certainly are not ready to begin to tell anything about it, until we have brought it down to the brick level of illustration. But, seriously, a brick is preferable for our purpose, because its three dimensions are all different, and cannot be mistaken for each other.

Now, if we were going to make a working drawing of a brick, we couldn't get along without at least three views of it: plan, side or front elevation and end elevation. Without all three views we would be very much in doubt about it, and even with all three it would be possible to be mistaken; so one is really not very much to blame, nor very much to be despised, if he is not quick to see the thing that a "draft" tries to represent. With only the plan before us (Fig. 2) the thing represented might be cylindrical or round in either direction. With plan and side elevation (Fig. 3) it might be elliptical in cross-section. With all three views (Fig. 4) it might have the straight lines and the square corners at the end shown and the corners might taper off and the other end of the object might be oval or semi-circular, and the drawing would still be a correct representation of it. So to bind the meaning of the drawing beyond all possibility of mistake, we would require a view of the other end of the brick (Fig. 5) or four views in all. But with an isometric projection of the brick(Fig. 6), we would require no label to tell us, "This is a brick," and we wouldn't find it possible to mistake it for anything else. By drawing the dotted lines (Fig. 7), the entire outline of the brick is shown. This is another advantage the isometric projection often gives us.

A correspondent is trying to cover 3½ inch by 6 feet shafts with plaster of Paris to finish 4½ inches. He is troubled with air holes in the plaster covering. Can any of our readers help him with their experience in the use of plaster of Paris?

Vertical Tapping Machine.

The accompanying engraving is of a vertical tapping machine intended for general work, using taps up to ¾″ diameter. The work to be tapped may be placed upon the table or into a suitable fixture placed upon it. The motion of the machine is reversed for backing out the taps by the lever shown at the right, the backing speed being double that of the working speed. The machine can be so constructed that the reversing can be done by the foot, leaving the hands free for handling the work. The platen is adjustable vertically, and can be let down to take in work 12″ high. The spindle is provided with a substantial chuck, which will hold any size tap up to ¾″. The machine is built by the Dennis Machine Co., Jackson, Mich.



VERTICAL TAPPING MACHINE.

LETTERS FROM PRACTICAL MEN.

Red or Yellow Prussiate of Potash—Keeping Freezing Water from Bursting Barrels—Water Tube Boilers.

Editor American Machinist:

Possibly your correspondent "W. B." (Question No. 53, Feb. 7,) has in mind the distinction between red prussiate of potash and the yellow prussiate. The red is chemically known as potassium *ferricyanide* and the yellow as potassium *ferrocyanide*.

In the answer to No. 52 of the same issue, you say that there may be some virtue in the placing of a stick of wood in the center of water tanks to prevent freezing. It is, I believe, an old Yankee practice to place a broomstick or something of that sort upright in barrels, etc., to prevent bursting by freezing. When the water freezes solid the tendency is to force the stick up out of the ice, and the latter cracks and bulges up around it. In this way the pressure tending to burst the barrel is undoubtedly somewhat lessened, but how much, is a question. It is apparently successful in such cases as I remember having seen, viz.: in barrels and hogsheads of rain water.

Mr. W. L. Hardy, in the issue of Feb. 7, advocates water tube boilers as opposed to tubular (shell) boilers for Western (I infer that he means Illinois) coal and water. Now I have had several years' experience with a well-known type, although not the latest pattern, of water tube boilers using Illinois coal and well water, and my conclusions are directly opposite to those of Mr. Hardy. I think that, under the above conditions, a man can get enough experience in six months out of four of these boilers to last a lifetime. In fact, they are perfect mines of experience. It certainly seems to me that it is much easier to keep the inside of the tubes in the ordinary boiler fairly clean, than it is to do the same for the outside of the water tubes. And as to scale, if the shell boiler is properly designed for bad water, it has the advantage there also. No one will question the greater efficiency of good water tube boilers with anthracite coal and good water, but, under the conditions which Mr. Hardy mentions, the questions of accessibility, and economy of repairs, should have great weight. These requirements seem to me to be fairly well fulfilled by the horizontal tubular boiler, having comparatively few and large tubes, and properly set for smoky coal. A. T. WOODS.

Champaign, Ill.

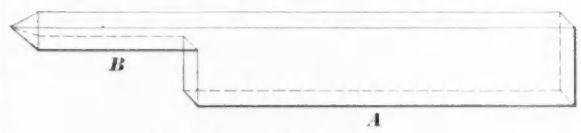
Device for Setting Tools.

Editor American Machinist:

Mr. Kelly's suggestion, in your issue of January 17th, of a center line on tail stock, while having the disadvantage pointed out by Mr. Miller, has not the range for general use, even though it could be relied upon as a center line, it being on the wrong end, especially when called upon for assistance by a boring tool, in which event we would have to swing the tool around after comparing its cutting edge with the line on tail stock.

I enclose a sketch of a little device for this purpose, which has served me well when turning or boring tapers; and also for setting tool when facing. It can be made of ¼ or ⅜ by 1¼ steel, its lower edge *A* to rest on the upper surface of tool-post rest, while the edge *B* is on a level with the center line of lathe; and after pointing and tempering it we have a fixed surface gauge, which is often called into requisition. In facing we are apt to find, when nearing the center, that our tool is too high or too low, which necessitates the readjustment of tool, and consequent variation in the cut, where one continuous cut would probably have finished the job, and, by a little scratch on a chalked portion of the face, with the point of this device, we could have set the tool accurately while out a distance from the center.

JOS. A. ROTHWELL.



DEVICE FOR SETTING TOOLS.

Proportioning Crank-Pins.

Editor American Machinist:

Being very much interested in the articles of Mr. J. G. A. Meyer on "Modern Locomotive Construction," I see he treats in his eighty-third paper on crank-pins, allowing a pressure of 1,600 pounds per square inch of projected area. Mr. W. H. Hoffman, in his articles on "Design, Construction, Repair and Management of Marine Steam Engines and Boilers," gives in his fifth paper (AMERICAN MACHINIST, May 5th, 1888,) a pressure of 400 pounds per square inch of projected area for crank-pins.

Although the conditions under which a marine steam engine has to work are widely different from those of a locomotive, still it seems to me that a difference of 1,200 pounds between the rules of Mr. Meyer and Mr. Hoffman is too great to be passed over without a discussion.

As all work given out by the crank-pin will produce heat, and as the amount of heat always is in exact proportion to the amount of work performed, it follows that a crank-pin for an engine running at 800 feet of piston speed per minute will have to be made larger than the crank-pin for an engine running only at a piston speed of 400 feet per minute, provided all other conditions are the same. It therefore seems to me that a rule for proportioning crank-pins ought to take into consideration the speed of the particular engine for which it has been designed.

The tendency at the present time is towards higher speeds and higher steam pressures, which in turn require larger crank-pins. Some of the best engine builders of this country have adopted the plan of making the diameter of the crank-pin larger than its length, which the writer believes to be a very good plan, especially for single disk crank engines, as this brings the pressure closer to the main bearing.

Making a crank-pin too small for its work will cause the heating of the bearing; on the other hand, making a crank-pin too large for its work will add unnecessary weight to the revolving parts of the engine, which again need counterbalancing, and will in turn cause a more violent vibration of the engine, when running at high speed. As the proportioning of the crank-pin is one of the most important parts in steam engine construction, it seems to me that it would be a benefit to many of the readers of the AMERICAN MACHINIST, if some experienced steam engine designers or first-class steam engine builders would give us their rules for proportioning crank-pins.

Ithaca, N. Y. LOUIS KUNZ.

Evidently Somewhat Discouraged.

Editor American Machinist:

Mr. Frank Richards has lately, in your columns, been giving young mechanics certain advice in regard to lines of study, etc., which advice is certainly good, and worthy the serious attention of those to whom it is addressed. The advice, however, is prefaced and interspersed with some ideas intended to be encouraging to those who see fit to follow the advice as given, which, if based on truth, Mr. Richards is entitled to all credit for bringing them out (or rather for reiterating them, as we have had them "fired at" us ever since I first entered the shop). If, however, they are based on a fallacy, then it is to some one's credit to expose the same. Please to understand that I have no wish to impeach Mr. Richards' *motive* in his writing, which, I am glad to believe, is of the best.

The first thing that I wish to object to is the idea that a young mechanic's wages or position will advance exactly as fast as he improves himself by study. I admit that Mr. Richards nowhere distinctly says that this is so, but this is the impression conveyed to me by a careful reading of the articles, and I am assuming that this is the impression which he wishes to make on those to whom his articles are addressed.

As regards wages—the wages of a man who has studied and improved himself will be governed, not by the amount of his knowledge, but by the number of other men who can offer services similar to his. It is not many years since expert telegraph operators received salaries of from $125.00 to $150.00 per month; this fact set a good many bright young men "studying" and practicing to become expert operators. Lots of them "got there," as far expertness was concerned. These same men now consider themselves fortunate if they receive from $75.00 to $85.00 per month, with no pay for "extra work," and the same thing is rapidly taking place in the profession of stenography. It is hardly necessary to multiply examples of this principle, which, I believe, is admitted by all who have given the subject any attention. As regards position (in the shop), leaving wages out of the question; a superintendent looking around the shop for a young man to promote, does not ask himself whether the young man is competent to calculate an eclipse, but whether he will be able to get the proper amount of work done by the men over whom he proposes to give the young man charge. If I was fortunate (or unfortunate) enough to be running a shop myself, I should know no other way to do, in order to compete with others in the same line. It is considering education as a principal, rather than an auxiliary matter, that makes trouble. A college graduate who depends on his education to get him a living will likely as not be peddling fish before he dies. The qualification that enables a foreman to get work out of the men is a business qualification, pure and simple, and has nothing whatever to do with mechanical ability or education; and because it is a business qualification, it gets more money on payday than a purely mechanical qualification does. There is no use in saying this is not so, or that it ought not to be so, or in getting angry about it. The question is: "What are you going to do about it?" Mr. Richards intimates that the young mechanic in the shop has a better chance to advance himself than the young clerk in the store. I claim that the reverse is the case, because the young clerk has a chance to study business methods. Let us look at this idea of business a little:

Business talent enables one man to control the labor of a large number of mechanics, to the great profit of the business man. Abnormal business talent, or perverted qualities that go to make business talent, enable one man to "hold up" a stage full of passengers way out West somewhere, and go through them all. It does not necessarily follow that normal business talent is not desirable.

It may be that the large number would starve if it were not for the intelligent controlling of their labor by the few. I must confess that I have no definite idea what the result would be if the control were wanting.

I do not expect anyone will thank me for saying these things. I know that, "while logic stops to argue, sophistry walks off with the cake." A few years ago, when some one was playing "Pinafore" every night, in almost every town, we all hated Dick Deadeye for telling what we knew was the truth, however unpleasant, and we all thought that Sir Joseph Porter, K. C. B., was a "good fellow" for saying: "Stick close to your desks (*i. e.*, study hard and become competent), and never go to sea, and you all may be rulers of the Queen's navee," although we knew in the bottom of our hearts that the thing was impossible.

I hope no one will suppose that I am kicking against educated mechanics; but education is certainly not the complete remedy for difficulties under which shopmen labor. A good many people, with the best of intentions, but who, as it appears to me, cannot see through a hole in a ladder, are continually crying "manual training" as a remedy for all industrial ills. "If all were skillful, all would receive good wages." Yes, but where are the wages coming from? Cannot these people see that the same law of competition governs the wages of all labor, whether skilful or not? and whether educated or not? Now, please to understand that I am not an individual with a low forehead and a dark complexion, "the effect of which is heightened by artificial aids which cost nothing," as Mark Twain said; neither have I a pocket full of dynamite bombs to throw at Mr. Richards the first time I see him. I am simply an ordinarily intelligent and inoffensive individual, a machinist who works in a shop by the day, but who does not believe in surface thinking, nor "glittering generalities." I have a reputation among some of those who know me best, of always seeing a funny side to things, but will confess that I can see nothing funny in the spectacle of an old man going around looking for a job at running a lathe, simply because he has followed the advice of some well-meaning man, and cultivated his mechanical talents instead of his business talents, supposing, of course, that he has any to cultivate. JAR-YES.

"Regarding Steel."

Editor American Machinist:

Let me add a few words to your note "Regarding Steel," of February 7th, and say that some steel makers find it difficult (sometimes impossible) to secure uniform treatment for the steel they send out, even though they may have full knowledge of the use to which it is to be put. This is probably true more frequently with high carbon steel than with the softer grades, for the reason that it must usually be more carefully heated, and also because, in so many cases, it must be

hardened and tempered—a task sometimes put into hands which may be willing enough, but which are not always skilled in such work. Very large amounts of these various grades of high carbon steel are now used in manufacturing establishments of all sorts, and an important fund of experience has been gathered in many of them. At the same time some of the most baffling complaints (amusing when hunted out) have arisen from the use of steel by some half-taught workman, who, for example, had decreed mentally that a certain tempering operation, because costly, was not needful, in spite of the fact that the work he had striven to copy from owed its success solely to the tempering thus neglected.

Pittsburgh, Penn. P. Barnes.

Editor American Machinist:

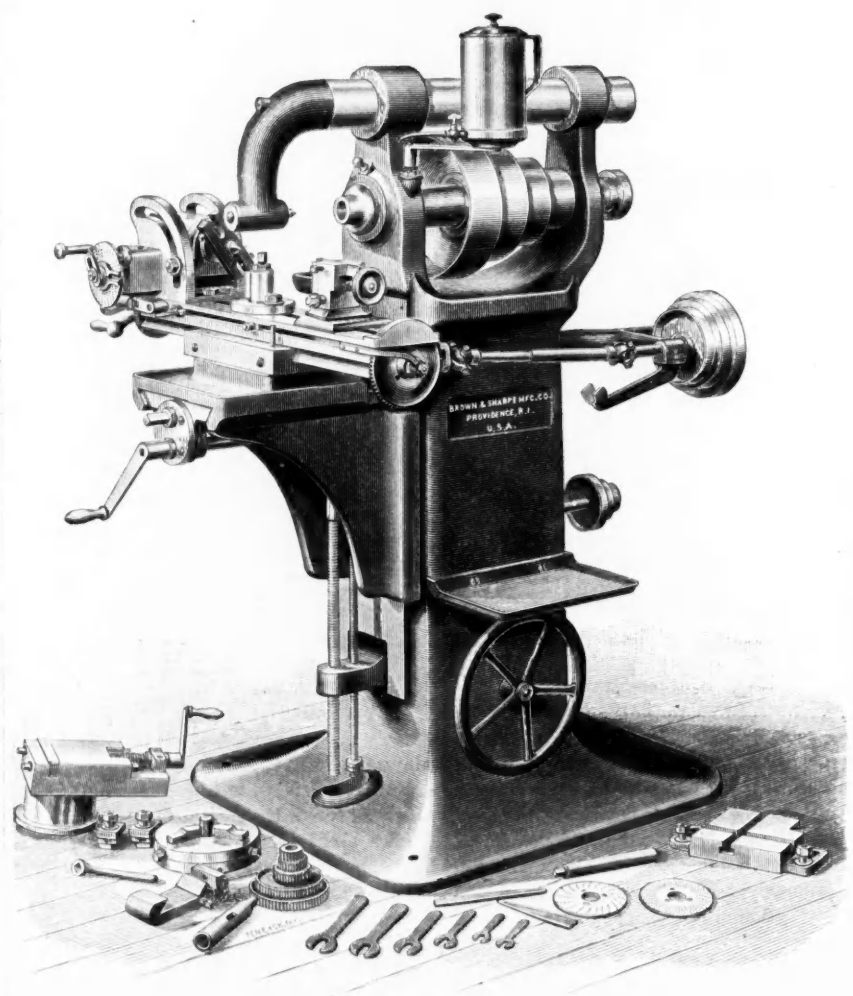
Your article "Regarding Steel," in your issue of 7th inst., is something to the point, and on a subject that should be more written about. It has revived some old thoughts in my mind, which I will offer you, in continuance, if you please, of the article referred to. While what you state are facts beyond dispute, it is also a fact that the steel user has always had trouble concerning the proper steel to be used for certain purposes. I write, hoping that the subject will be taken up all along the line until a plan may be adopted that will settle the matter and place all trouble (if any arising from putting steel to uses other than it was intended for) properly upon the consumer.

What I think would be the proper plan would be to brand each bar with the name of the maker, also for what purpose it is best adapted, thus "Crescent," "Taps," "Crescent Reamer," "Black Diamond," "Drills," etc. Were this plan adhered to strictly to the letter, it would serve the double purpose of advertising and insuring justice to the manufacturer, as well as save a great deal of trouble, such as I once had on taking charge of a shop, at one time, where there was a good variety of steel in stock, from which I had some tools made which failed to do the work. For instance, from a bar of 1⅞" round "Black Diamond" steel, we made a hollow mill which worked very nicely, but was too brittle, on account of the thinness of the shell, which took temper too freely. Then from the same piece we made a large pipe tap and drill combined. In tempering this we found that the grade of steel seemed different, the point of the drill being brittle, like the mill above mentioned, and the body of the tap would not temper sufficiently to keep it from crushing while in use. I found great trouble in all the pieces on hand. The consequence was that it became necessary to use the whole lot for saw mandrels, piston and pump rods, etc., instead of using a cheaper grade, such as machine steel. We then laid in a new supply of tool steel; since that time I have been advocating the plan above mentioned. Let the brand be stamped into the bar at one extreme end, then if the user cuts or uses that end first, and loses all knowledge of his steel, it is simply his fault. Another very expensive experience with the same "conglomerate mess" above mentioned was with a large bar 3"x4", there being about 4 feet remaining, which I supposed was for making trip-hammer dies, and having a solid die to make for threading some wrenches (our specialty), I concluded this would be the best material. We cut off a piece 1½" thick across the bar; when finished it tempered well and did good work, so I naturally concluded the piece good steel, but after making a set of dies for the trip-hammer we found it would not temper in a large body sufficient to stand up under the blows of the hammer. Had the bar been branded I would not have had the above trouble.

When we see octagon steel we always know it is intended for chisels, and if we make taps from it, it is at more or less risk. I hope we can awaken a little interest in this matter, and hear from some of our manufacturers. Why not brand each bar of steel the same as some mills do their catalogues? It would be easy, profitable, and save any amount of trouble. Always remember if a lathe, planer and drill press looked exactly alike we would be trying to do a planing job on the drill press, or turning job on the planer; but these tools are made octagon, as it were, so we know at a glance what they are intended for. A User.

An Addition to the Brown & Sharpe No. 1 Milling Machine.

Our readers, all of whom are of course familiar with the Brown & Sharpe Mfg. Co.'s No. 1 Universal Milling Machine, will be interested to know that they have added to the machine an overhanging arm in which is a center for supporting the outer end of the arbor, the machine remaining in other respects identically the same. The housings are simply extended up above the main spindle boxes and bored out to receive the arm, which is cylindrical and is a sliding fit through its bearings, capable of being clamped in any desired position, turned up out of the way when required, or entirely removed by simply drawing it out. It is a feature which many of the friends of the machine have regarded as the one thing needed to make it perfect; for on many jobs, especially those in which for any reason the cutter had to be used at a considerable distance from the main bearing, no arbor could be used which was stiff enough to allow of working the machine to its full capacity—a difficulty, which is of course removed by the outer arbor support. Still, there will probably be some who will prefer the machine as it has been, *i. e.*, without the arm—for its desirability will of course depend somewhat upon the character of work to be done—and it is therefore to be furnished hereafter with this new feature or without it, as may be preferred.



No. 1 Milling Machine with Overhanging Arm.

The Daft Motor on the Elevated Road.

In response to an invitation, a representative of this paper accompanied Mr. Leo Daft during several trips of his electric motor which is now being tested upon the Ninth avenue line of the Elevated R. R. in this city.

The motor, which weighs ten tons, is running from 14th street north about two miles and return, drawing three regular cars unloaded, and runs between the regular trains drawn by the regular locomotives. The part of the road over which it runs contains the heaviest grades in the elevated system, part of the way being a grade of 98+ feet per mile. The motor handles the train very well, and the switching of the train from one track to the other, and that necessary to bring the motor in front of the train each way, is done with all the facility that attends such operations by the regular locomotives. It is evident, however, that several changes will need to be made in the arrangement of the various levers by which the motor is handled to bring it more thoroughly under the control of the one man who should be responsible for its safe management. These changes, we are informed, are being made in a larger and heavier motor which is now being constructed. This, so far as we know, is the first instance of the trial of an electric motor in competition with and running over the same road as steam locomotives, and the result will be watched with considerable interest. The present test with empty cars can of course only demonstrate the practicability of handling the train under various conditions, and in part the degree of economy which may be hoped for. Only the trial of the twenty-ton machine now being constructed, under the ordinary running conditions of the road can fully demonstrate the success or failure of the enterprise.

Peculiar conditions present themselves in the present instance, which are favorable to the electric motor in its contest with the locomotive. These conditions are, that the elevated roads are now admitted to be very nearly if not quite up to the utmost limit of their carrying capacity, and in fact are driven during certain hours of the day far beyond their normal capacity, *i. e.*, their capacity for carrying passengers comfortably and safely. The trains are run as close together as possible, and are as heavy as can be drawn with the present locomotives; and no heavier locomotives can be used, because the structure will not safely support them. The weight of the locomotive is all placed upon the drivers, and from the fact that this weight cannot be increased, the limit of tractive force seems to have been reached.

Now as trials have shown, the tractive force of an electric motor, where the rails constitute part of the circuit, is about twenty-five per cent. greater than with a locomotive of the same weight. This is not due to magnetic attraction, and in fact the cause is not understood, but it is known to be a fact, and it is owing to this, that electric motors used in the streets of cities easily ascend grades which would be impracticable for locomotives. If the elevated roads can obtain motors weighing no more than their present locomotives, but which will nevertheless have twenty-five per cent. greater tractive power, it is evident the carrying capacity of the roads will be increased by about that amount, and that would probably be a prime consideration. As to the comparative economy as compared with the locomotives now in use, we do not believe much can yet be said with any certainty. Supposing a loss of thirty-three to fifty per cent. by the conversion of the rotative force of the stationary engines into electricity, and its reconversion into rotative force in the armature of the motor, it would probably be compensated for by the superior economy of compound condensing engines of the best type, which would probably be used for driving the dynamos, as compared with that of the locomotives, which, with their frequent stops, run under conditions specially unfavorable to economy. The current used is not, it is claimed, liable to destroy life, but it is admitted would give one who should come in contact with it a shock which would at least be unpleasant. Whether this can be reconciled with the fact that men must be constantly employed upon the tracks, who would probably object to receiving unpleasant shocks occasionally, we cannot say. This is a point for consideration.

A Restaurant in a Steel Works.

Knowing by practical experience and observation that shop men have no great love for the dinner bucket, an article in *The Post*, of Pittsburgh, entitled "Good-by dinner buckets," attracted our attention. We found the article to be an account of a restaurant, recently started at the "Crescent" Steel Works for the accommodation of the workmen, by the owners, Miller, Metcalf & Parkin. It seems that for some time past there has been in the works a dining-room for the clerks and officials employed in the offices, and the idea occurred to extend the system so as to include the shop men. A second story was added to the machine shop, and fitted up for the accommodation of about ninety men, and we should judge, from the account given in *The Post*, it is a move likely to become very popular.

Not only is the room elegantly fitted up and furnished, but the bill of fare is excellent; and from the fact that provisions are bought at wholesale prices, and meals furnished to the men at cost, prepared by a competent cook, using the best of modern appliances, it will be seen that there will be little further use for the despised dinner pail, and no necessity for going out to lunch-rooms where questionable, if not positively injurious stuff, is served up at exorbitant prices. We hope and believe that the plan will succeed, and that Messrs. Miller, Metcalf & Parkin will have no cause to regret the establishment of the enterprise. It is distinctly announced that there is no element of charity in the matter, but it is simply a case of co-operation between employer and employes for mutual benefit.

The Pond Machine Tool Works at Plainfield, N. J., are getting out drawings for a 36" lathe, which, when it is set up in the shop it is destined for, will probably be called an "18" center lathe," since it is going to Manchester, England, to be used in making the Westinghouse engine there. It will have two tool blocks upon the cross slide, each moved by an independent screw, and having an automatic feed. One of these screws is connected with a sliding block, which fits the guide bar of a Slate taper attachment, and the automatic-cross feed can be thrown in for both screws at the same time, or for either one without the other.

They are using in the shop thin sheet-iron as a mounting for blue prints, and it is proving very satisfactory. It is cold rolled, has a smooth surface, and is cut into two different sizes for blue prints used in the shop. It is practically indestructible, quite light, and inexpensive. The iron is first varnished on both sides with shellac varnish, then the blue print is put on with a paste composed of ordinary starch, after which the face of the print is varnished with the shellac. Mr. Greensmith, the chief draftsman, says he experimented with a good many kinds of paste before finding a satisfactory one, and that starch is the only thing found which would answer. He also found that, unless the iron is previously varnished, it oxidizes under the print and spoils the lines.

Modern Locomotive Construction.

By J. G. A. Meyer.

EIGHTY-FIFTH PAPER.

Fig. 472 represents a rear crank-pin for an eight-wheeled passenger engine; in fact, this figure and Fig. 471 (last paper) represent a pair of crank-pins for an engine of this class.

Figs. 474, 475 represent another pair of crank-pins for the same class of engine; they were made of steel, and designed for an engine having cylinders 17 inches diameter. Fig. 474 represents the main, and Fig. 475 represents the rear crank-pin; their forms, as will be seen, differ somewhat from the forms of the pins previously referred to.

The general practice is to make the diameter of the outer collar (see Fig. 471) from 1 to 1½ inch greater than the diameter d of the journal C; the diameters of the middle collar and the collar next to the hub of the wheel, are generally made 1½ inch greater than the diameter D of the journal B. The thickness h of the outer collar is generally ½ inch sometimes ⅝ inch. The thickness g of the middle collar, and the thickness f of the collar next to the hub of the wheel, will depend upon the distance between the line coinciding with the axis of the cylinder and the face of the hub of wheel. In many eight-wheeled passenger engines the thickness g is ½ inch, and the thickness f ⅝ inch.

Sometimes the hub of the wheel is made exceedingly deep, leaving no room for a collar next to the hub; in such cases the main crank-pin will appear as shown in Fig. 474. The diameter of the wheel fit of this crank-pin is made comparatively large, so as to obtain a shoulder against which the brasses of the main rod can bear; this shoulder generally projects $\frac{1}{16}$ of an inch beyond the face of the hub.

The junctions i, i, of the journal and the face of the collars should in every instance be curved surfaces turned to a radius of ⅛ inch for small crank-pins, and increased up to a radius of ¼ inch for large pins.

In many rear crank-pins the shank E is formed so as to leave a collar next to the hub of the wheel, as shown in Fig. 472. The diameter n of this collar is made equal to that of the corresponding collar on the main crank-pin, and its thickness p is generally ⅝ or ¾ of an inch. The diameter m of the shank E is generally made from ¼ to ½ inch greater than the diameter D of the main rod journal.

Fig. 473 also represents a rear crank-pin for an eight-wheeled passenger engine. The shank E of this pin has a uniform taper nearly throughout its whole length; the diameter n is made—as the diameter n of the collar of the shank in Fig. 472—equal to the diameter of the collar on the main crank-pin; that is, the collar next to the hub. Making the form of the shank like that shown in Fig. 473 increases the weight of the pin unnecessarily; it does no good, and therefore this form of shank is not recommended. Indeed, in order to reduce the weight of the rear crank-pin, some locomotive builders make its shank E like that shown in Fig. 479; this rear crank-pin has a collar on each side of the journal, and the diameter r, next to the inner collar, is generally made ¼ of an inch greater than the diameter d of the journal.

Figs. 476, 477 also represent a pair of crank-pins for an eight-wheeled passenger engine, having cylinders 17 inches diameter. It will be noticed that the shank E of the rear crank-pin, Fig. 476, is different in form from those previously shown. Here the diameter s, in the center of the shank, is made less than the diameter k, or the diameter of the wheel fit. The object of this design of crank-pin is to reduce its rigidity, so that when the crank-pin is subjected to a sudden stress or shock, the slight flexibility which this crank-pin may possess will lessen the effect of the shock, and thus reduce the chances of breaking. Of course, the proportions of this crank-pin must be such that none of its fibers will be strained beyond the limits of elasticity. These crank-pins are used to quite an extent on one of our prominent roads, and give good satisfaction. On other roads this form of crank-pin is seldom found. The reason why this form of crank is not generally adopted is probably on account of the difficulty of determining its correct proportions; in fact, these proportions are generally obtained by a tentative process rather than by computation.

Figs. 478, 479 represent a pair of crank-pins for an eight-wheeled passenger engine, with cylinders 17 inches diameter; they are also often used for the same class of engines with cylinders 18 inches diameter.

These crank-pins are designed for engines which have solid-ended side rods. One of these rods is shown in Fig. 419.

In eight-wheeled passenger engines the diameter of the wheel fit on the rear crank-pin is always made equal to the diameter of the wheel fit on the main crank-pin. This diameter should never be made less than the diameter D of the journal next to the wheel; in fact, we believe it to be good practice to make the diameter of the wheel fit from ⅛ to ¼ of an inch larger than the diameter D.

When the crank-pin has a collar next to the wheel, the junction of the wheel fit and the face of the collar should never be a sharp corner, but should be well rounded out.

The crank-pins are generally pressed into the wheels. When the hole in the hub of the wheel is perfectly true and smooth, the crank-pin should be pressed in with a pressure equal to about six tons for every inch in diameter of the wheel fit. When the hole is not perfectly true, which may be the result of shrinking the tire onto the wheel center after the holes for the crank-pin have been bored, or if the hole is not perfectly smooth, the pressure may have to be increased to nine tons for every inch in diameter of the wheel fit. From these remarks it appears that it is always best to shrink the tires onto the wheel centers before the holes for the crank-pins are bored.

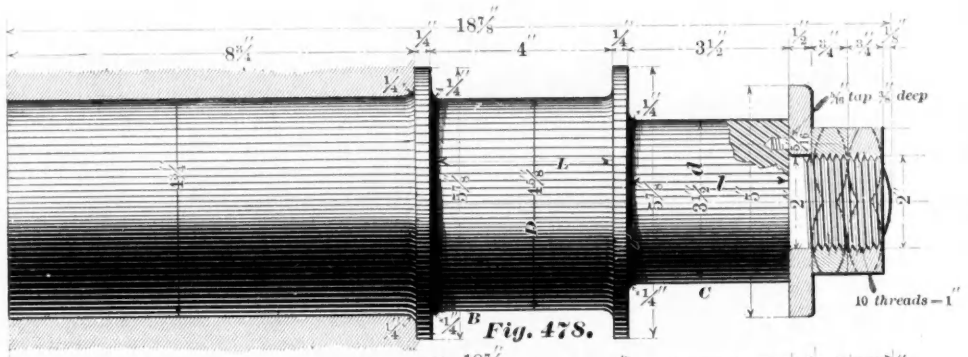


Fig. 478.

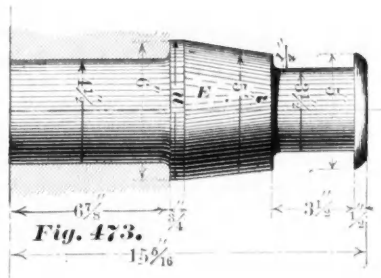


Fig. 473.

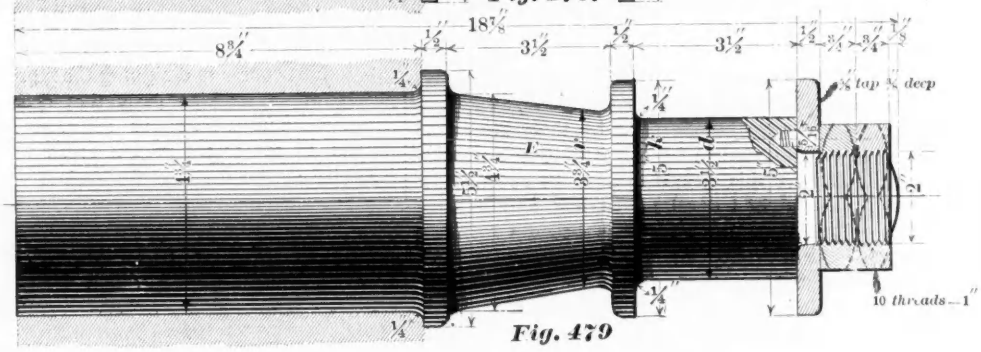


Fig. 479

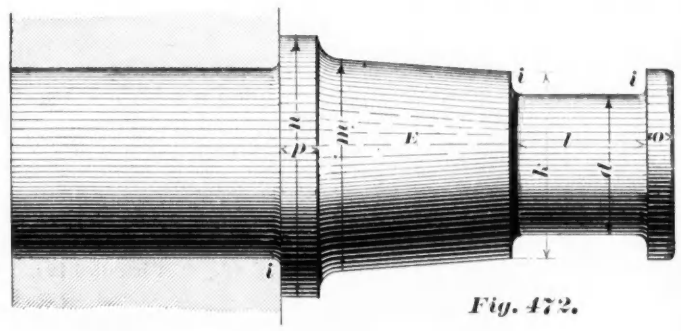


Fig. 472.

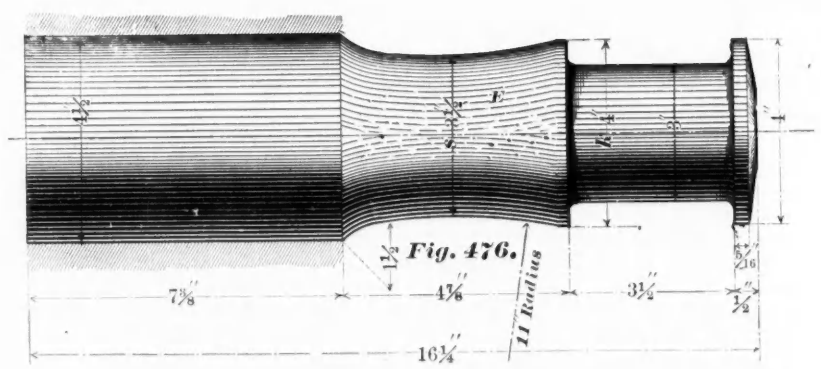


Fig. 476.

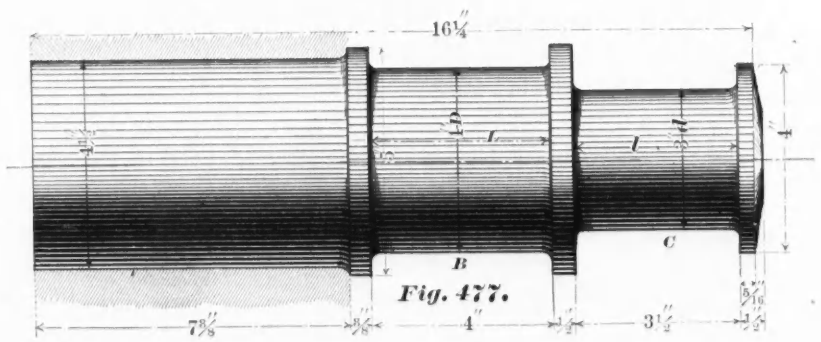


Fig. 477.

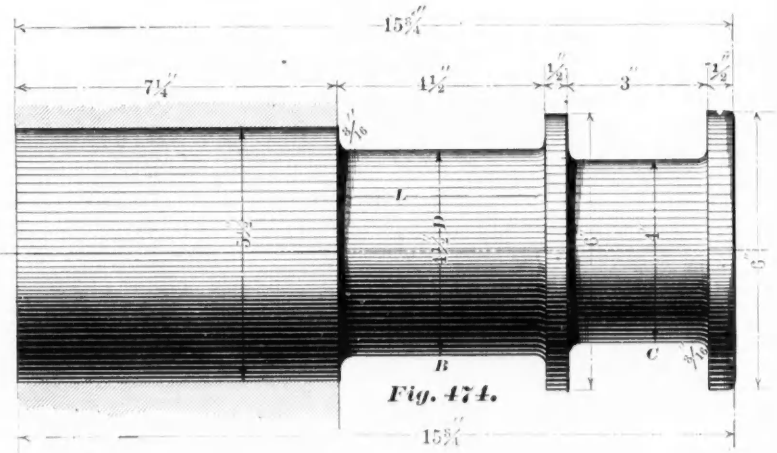


Fig. 474.

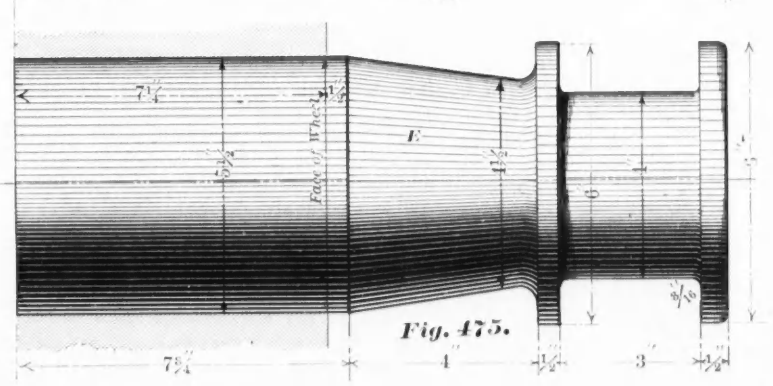


Fig. 475.

In Montpelier, Ind., it is noticed that the flow of natural gas follows the ebb and flow of the tides, the pressure varying widely, or so much so that part of the day it is barely possible to get the desired supply, while at other times the pressure is so great as to be objectionable.

AMERICAN MACHINIST

To prevent delays all Communications should be addressed to the Company.

PUBLISHED WEEKLY
BY
American Machinist Publishing Co.
96 Fulton Street, New York.

HORACE B. MILLER, Pres't and Bus. Manager.
LYCURGUS B. MOORE, Treas. and Sec'y.

F. F. HEMENWAY, Editor and Mech. Engineer.
J. G. A. MEYER, } Associates.
FRED J. MILLER, }

Special Announcements.

☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale. We give no premiums to secure either subscribers or advertisers.*

☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once.*

Subscription.

$2.50 a year in advance, postage prepaid in the United States, Canada and Mexico.
$3.50 a year to Other Countries, postage prepaid.

Advertising.

Transient, 35c. per line, each insertion.
"Business Specials," 50c. a line.

The American News Company,
Publishers' Agents, New York.
The International News Company,
11 BOUVERIE STREET, Fleet Street, LONDON, ENG., will receive subscriptions for the AMERICAN MACHINIST, at 14/7 per annum, postage paid.

DEALERS SUPPLIED BY
The Albany News Company, Albany, N. Y.
The American News Company, New York, N. Y.
The Baltimore News Company, Baltimore, Md.
The Brooklyn News Company, Brooklyn, N. Y.
The Central News Company, Philadelphia, Pa.
The Cincinnati News Company, Cincinnati, Ohio.
The Cleveland News Company, Cleveland, Ohio.
The Colorado News Company, Denver, Colorado.
The Detroit News Company, Detroit, Mich.
The International News Company, New York, N. Y.
The Minnesota News Company, St. Paul, Minn.
The Montreal News Company, Montreal, Canada.
The National News Company, New York, N. Y.
The Newark News Company, Newark, N. J.
The New England News Company, Boston, Mass.
The New Orleans News Company, New Orleans, La.
The New York News Company, New York, N. Y.
The Northern News Company, Troy, N. Y.
The Omaha News Company, Omaha, Neb.
The Pittsburgh News Company, Pittsburgh, Pa.
The Rhode Island News Company, Providence, R.I.
The San Francisco News Co., San Francisco, Cal.
The South West News Company, Kansas City, Mo.
The St. Louis News Company, St. Louis, Mo.
The Toronto News Co., Toronto, Ontario, Canada.
The Toronto News Co., Clifton, Ontario, Canada.
The Union News Company, New York, N. Y.
The Washington News Company, Washington, D. C.
The Western News Company, Chicago, Ill.
The Williamsburgh News Co., Brooklyn, E. D., N. Y.

NEW YORK, FEBRUARY 21, 1889.

CONTENTS.

	PAGE
A Heavy Planer and Matcher	1
Practical Details of Blacksmithing. By B. F. Spalding	1, 2
Plain Words on the Piece-Work Question. By Joshua Rose, M. E.	2, 3
Drilling Machine—Link Milling Machine	3
The Massachusetts Institute of Technology	3
Shop Notes	3, 4
Chilled Castings. By S. Bolland	4
Self-Instruction for Young Mechanics. By Frank Richards	4
Vertical Tapping Machine	5
Letters from Practical Men: Red or Yellow Prussiate of Potash—Keeping Freezing Water from Bursting Barrels—Water Tube Boilers. By A. T. Woods—Device for Setting Tools. By Jos. A. Rothwell—Proportioning Crank-Pins. By Louis Kunz—Evidently Somewhat Discouraged. By Jar-Yes—"Regarding Steel." By P. Barnes and "A User"	5, 6
The Daft Motor on the Elevated Road	6
An Addition to the Brown & Sharpe No. 1 Milling Machine	6
A Restaurant in a Steel Works	6
Modern Locomotive Construction. By J. G. A. Meyer	7
Insurance which Assures	8
Rapid Transit in New York	8
The Problem of the Individual	8
Literary Notes	8
Questions and Answers	8, 9
Manufactures	9
Machinists' Supplies and Iron	10

Insurance which Assures.

Sometime last year we printed, on this page, an article calling the attention of manufacturers to the importance of a consideration of the means by which shops could be so constructed as to reduce to the minimum insurance charges and fire risks.

This called out, it will be remembered, an article from Mr. C. J. H. Woodbury, M. E., in which he took issue with us upon some points, but which was, nevertheless, gladly welcomed to our columns as a valuable contribution to the subject of "shopitecture," by one who has made a special study of the subject, and is well qualified to speak with authority. Mr. Woodbury took the ground that a thoroughly fire-proof construction, in the full meaning of the term, was practically impossible to begin with, and that those forms of construction called fire-proof, entailed excessive rental charges, and for these reasons should be replaced by a lighter and less expensive construction, so planned as to make its combustion so slow as to give ample opportunity for extinguishing fires or at least confining them to a very small portion of the buildings. Such a form of construction was shown, by illustrations accompanying the article, which was published in our issue of Nov. 10, 1888.

In the current number of *The Century*, Mr. Edward Atkinson goes more fully into the subject, using, among others, the same drawings used by Mr. Woodbury. As would naturally be expected, from the fact that Mr. Atkinson is at the head of an insurance company, which, instead of devoting its energies to the sole object of getting the highest possible premiums upon every risk offered to it, tries by every possible means to reduce fire risks, the subject is handled in a masterly manner. The article should be read by every manufacturer who is or may be so situated as to exert an influence upon the matter of shop plans.

Mr. Atkinson places the annual fire tax of the United States in normal years, *i. e.*, in which no great conflagration occurs, at a minimum of $180,000,000, and shows conclusively, we think, how this enormous tax can be reduced to a mere fraction of the present sum, with the additional advantages of the possession of buildings better adapted to their purpose, and more comfortable for their inmates.

This study of building constructions with a view to the elimination of fire risks, as far as may be possible, and then the distribution of the remaining losses over as wide an area as possible, is undoubtedly the true beneficent function of insurance, and we hope to see the principle extended to marine and other lines of insurance, where it is sadly needed. It seems to us, for instance, that there ought to be a field for a company which should make a specialty of showing manufacturers and other employers of labor how to reduce the risk of accident to employes to the lowest possible point, and of insuring them against the remaining risk of liability for damages awarded by the courts. Such an insurance company would, we believe, be able to do much good, both to employes and to employers of labor; but it should be organized and managed upon the same general plan as the fire insurance company in Boston, of which Mr. Atkinson is the head (and with which Mr. Woodbury is also connected professionally), and which has accomplished so much good in its special field.

Rapid Transit in New York.

It is urged upon Mayor Grant, of New York, that he organize a Rapid Transit Commission, to devise plans for rapid transit in New York City. If Mayor Grant were permitted to proceed as mayor of New York just as he would do if it was a private matter with him, there is little doubt that he would successfully solve the problem. As plain Mr. Grant he would engage the services of competent engineers, and a plan would be forthcoming. But as Mayor Grant there is a political complexion to the case that puts quite a different aspect upon it. There was a commission appointed, a good while ago, that was to get electric wires in New York under ground, without delay. Most everybody remembers the farce that commission has enacted. If the Rapid Transit Committee of the Real Estate Exchange, which has appealed to Mayor Grant in the matter, is really in earnest, it should pin no faith to a "commission."

The Problem of the Individual.

Among the "Letters from Practical Men" this week will be found one which takes up the subject of technical education, the opinion of the writer seeming to be that there is not much to hope for, either by individuals or by communities, in the general diffusion of technical knowledge. While there is, undoubtedly, a vein of truth running through the communication, yet we must take issue with the general conclusions drawn. It is true that, under our present social system, there is a close competition among workmen for the desirable situations, but we believe there always will be this competition under any industrial system except socialism, which we do not believe in, and do not suppose our correspondent believes in. For we believe that, so long as one position is more desirable, or more remunerative than another, it is right and proper that competition should take place among those qualified to hold desirable positions, and that he who proves the better qualified should obtain the place, as he usually does, though of course there are exceptional instances in which he does not. We believe this competition to be necessary to the highest development and happiness of mankind, and that it is because socialism would destroy this competition, or, at least, remove most of the incentives to special training and effort by individuals, that it would operate to prevent the highest development and happiness of mankind. We do not, of course, think it is desirable, or even necessary, that men should be forced to compete with each other for the bare opportunity to sustain life; but for all those occupations which require special fitness or training, and which yield to him qualified to pursue them specially large returns, it seems to us proper that there should be competition. The number of places in such occupations is always limited; those best qualified should occupy them, and how better can qualification or fitness be determined than by competition?

While it is true, as our correspondent says, that the wages of a man who has studied and improved himself will be regulated by the number of other men who can offer similar services, yet it should always be remembered that, the more a man has studied and improved himself, the fewer other men will there be who can offer services equal to his, and the less competition he will therefore have to contend with. Not every one who studies to improve himself in his business will meet with success, either in mechanical or other pursuits, but it is almost certain that he who does not make an effort to improve himself, or to rise above the general average, will never meet with very gratifying success, and will always have the maximum of competition to contend against. It is mainly because not every mechanic, and not every reader of the AMERICAN MACHINIST, will or can take the advice of Mr. Richards, that the following of his advice will be attended by results beneficial to the comparatively few who do follow it.

As to the proper qualifications of foremen in machine shops, we can only say that, in our opinion—according to our experience and observation—the most successful ones are good mechanics, whatever other qualities they may have in addition. We believe that business qualifications alone very rarely, if ever, make a good foreman in a machine shop, foundry, or anywhere else where skilled labor is to be supervised.

The problem which presents itself to every individual in this country is, how can I qualify myself to render to the community the very best and most valuable services of which I am capable? The general answer to this problem is found in a wise decision, as to what pursuit one is best qualified for, and then an honest, persistent, systematic and intelligent effort to climb just as high as possible in the chosen occupation.

Altogether the most important advance recently made in relation to national offense and defense is the finding of means of safely using modern high explosives in shells. But there is danger that the attention given to so-called dynamite guns in this country, will call attention away from the fact that such guns alone should not be depended upon. There is need of such guns, and everything possible should be done to perfect them. But while working in this direction it should be remembered that long-range guns are also needed. There is need of long-range, heavy-caliber guns, such as are made in Europe—only more so.

The facility with which dynamite guns can be made, and their destructive qualities under favorable conditions, should not bring about apathy in regard to the value of guns of the immense range of some now being made in Europe.

Literary Notes.

ELEMENTS OF MACHINE DESIGN: Notes and Plates for the use of Students in Lehigh University. By J. F. Klein, Professor of Mechanical Engineering.

The notes and plates in this book constitute a short course in designing the most important of the machine parts that occur in practice. The proportions are either inscribed on the plates or are given by the formulas and tables; the dimensions are to be calculated in all cases from the data given in the text. It treats on rivets and riveted joints for wrought-iron boiler plates; fastenings by means of bolts and nuts and set screws. It also gives methods of securing nuts. Various joints for connecting parallel plates and plates not in the same plane, such as are frequently met with in boiler work, are illustrated, and their proportions given. The book also contains notes on, and illustrations of stay bolts, braces, wrought-iron rings for furnace openings, and other details of boiler work. Formulas for keys, for pulleys, wheels, cranks, etc., and gibs and cotters for connecting rod straps, also formulas for finding the dimensions of connecting rods with circular, rectangular, and I sections are given. It treats on belt gearing, giving the dimensions of belt pulleys; with notes on cross-sections and specific duty of belts, and many other details of machine design. Special attention is called to the new table for finding speed cone diameters, and for laying out exactly the profiles of teeth by means of rectangular co-ordinates. These tables are exceedingly useful and valuable. The author does not claim to give a complete treatise, even on the machine parts represented, and therefore frequent reference to the larger works of Reuleaux and Unwin will be found desirable. The book shows marks of scholarship throughout, and will be appreciated by the students of mechanical engineering, and by practical men who have a knowledge of the higher branches of mathematics. Applications for the book should be sent either to Prof. J. F. Klein, or to E. G. Klose, 146 South Main street, Bethlehem, Pa. The price of the book is $6.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(71) C. S. M., South Boston, Mass., writes: Will you please give me the name of a book which treats on locomotive valve setting? A.—We believe that you will find this subject thoroughly explained in our issues of April 30th, May 14th and 28th, 1887.

(72) G. W. P., Lindsey, Pa., asks: Is there a particular kind of metal for making chilled tread mine car wheels? Please give us all the in-

formation you can. *A.*—We referred this question to Mr. S. Bolland, who is an experienced moulder. His answer we have given in a separate article, headed, "Chilled Castings," in this issue.

(73) J. H., Philadelphia, Pa., asks: What will remove bluing from steel that has been previously polished, and leave the polish unimpaired? *A.*—We know of no better way than to do it with fine emery cloth or paper, and oil. 2. Is there not something which will blue steel as in gun barrels, besides heating them? *A.*—See answer to Question 47, Feb. 7 issue.

(74) T. S. J., Halifax, Nova Scotia, asks: How can I get the proper radius for a locomotive link? *A.*—The radius of links in nearly all locomotives is made equal to the distance between the center of the main driving axle and the center of the link block pin (sometimes called the lower rocker arm pin), when the latter stands in the center of its travel. See AMERICAN MACHINIST, February 26, 1887.

(75) J. C., Lincoln Park, N. J., asks: Would there be any constant draft to a chimney built out from any building without having some heat produced at the opening in the bottom? *A.*—The draft in cases of this kind will greatly depend on the condition of the outer atmosphere and the temperature of the room. You may or may not have a draft; and whether the draft under these conditions will be constant is very doubtful.

(76) A. N. B., Erie, Penn., writes: Will you please inform me what salary (as draftsman) a mechanical engineer and draftsman well up in mathematics, mechanics and steam, with practical experience of pattern making and vise work, and who has had five years' experience in designing and general office work in Canada and in England may expect? I am an Englishman but recently come to the United States. *A.*—There is no standard salary for draftsmen. It will greatly depend on the kind of work you are engaged upon, and your ability to do the work. The pay will range from $2.50 per day to a salary which your ability may command.

(77) "Worm Gear," Rochester, N. Y., asks: Where is the pitch line of a worm gear when the gear is hollowed out on the face to fit the worm? *A.*—There is a difference in practice with regard to this matter, some making it at half the working depth of the teeth in the center of the face of the gear, others making it at half the working depth of the teeth at the sides. There is the most authority for the former practice, and we do not think it is ever put at the bottom or at the top of the teeth in the center of the face, except when the top of the tooth at the center coincides with the center of their depth at the sides, which, of course, might sometimes happen.

(78) P. M., Cleveland, Ohio, asks: How is the diameter of a safety valve determined from a given pressure and other data? *A.*—According to the General Rules and Regulations prescribed by the Board of Supervising Inspectors of Steam Vessels, lever safety valves which are to be attached to marine boilers shall have an area of not less than one square inch to two square feet of the grate surface, and the seats of all such safety valves shall have an angle of inclination of 45 degrees to the center line of their axes. For stationary boilers working under the ordinary pressures, it is good practice to give 1 square inch for 1¾ to 2 square feet of grate surface. 2. How is the diameter of a circle found when only its area is known? *A.*—Divide the area by .7854, and extract the square root of the quotient; this will be the diameter of the circle.

(79) S. C. W., Philadelphia, Pa., writes: I want to use soda (carbonate) in my boilers to remove the scale, but I don't know that it is generally used. How often, and how much at a time should I use? The boiler is 16 feet long and 4 feet diameter; it is made of steel. The water due to condensation is returned to the boiler. We heat with the exhaust steam. *A.*—Carbonate of soda is frequently used for removing scale. It is recommended that, if the boiler is badly scaled, and if it can be spared from use, a good plan to clean the boiler is to put in a quantity, say one pound for each horse-power, and keep the boiler under steam, say 40 to 50 pounds' pressure, and let it remain so for 24 hours and then wash out. If this don't answer try another dose. The amount of soda to be used daily will depend on the quality of the water, and must be determined by your own good judgment. Start with about two pounds per 24 hours, and gradually increase the dose, if necessary; or decrease the dose if it causes the boiler to foam.

(80) E. C. D., Pawtucket, R. I., sends us sketches of two inclined planes; one plane is 12 inches long, the other one is 24 inches long; the height of both planes is 2 inches. He asks: Suppose a ball is allowed to roll down these planes, will the ball have a greater force on reaching the bottom of the 24-inch plane than it will have on reaching the bottom of the 12-inch plane? I claim that the ball will have the greater force on reaching the bottom of the 24-inch plane; others say that there will not be any difference. *A.*—Leaving friction and other resistances out of consideration, we have the following law: The velocity acquired by a particle in falling from one point to another, when there are no resistances, will be independent of the path over which it moves, and will equal the velocity acquired in falling vertically through a height equal to the height of one point above the other. From this we conclude that the ball on reaching the bottom of the short plane will have the same velocity as it will have on reaching the bottom of the long plane; and since the mass of the ball is not changed in either instance, it must have the same momentum on reaching the bottom of either plane, and consequently, in both cases, it will have the same amount of kinetic energy, and will be able to perform the same amount of work. Therefore, the force which the ball can exert in reaching the bottom of these planes will be the same in both instances.

(81) H. E. S., Pittsburgh, Pa., writes: I have a great many disputes as regards the boiler in use on the Amoskeag Fire Engine. It has always been termed a submerged flue boiler, yet it is claimed that it is a tubular boiler. My claim is that it (the Amoskeag) is not a tubular boiler in the sense that a fire engine boiler is tubular now-a-days, where the water and steam are inside the tubes, while the whole boiler remains the flue for draught. *A.*—The terms "tubes" and "flues" are sometimes indiscriminately used; for instance, some locomotive builders, who are accustomed to building one class of boilers only, will use the term flues instead of tubes, and we believe it is safe to say that these remarks apply to fire engine builders also. Hence, it should not be a matter of surprise that there should be some confusion as to the terms tubular and flue boilers; particularly when it is remembered that in some cases it is difficult to draw a line between the two types of boilers. In practice, it appears that the ratio between diameter of the tubes or flues and that of the shell determines whether it is proper to apply the term tube or flue. For instance, a boiler 42 inches diameter, having 6 flues each 6 inches diameter, will be called a flue boiler and not a tubular boiler; this boiler is said to have flues, not tubes. On the other hand, if these same flues are put in a boiler 10 feet diameter, we would use the term tube and not flue; and call this large boiler a tubular boiler. In ordinary practice flues are generally 8 inches and upwards in diameter, and tubes do not often exceed 4 inches in diameter. For boilers having tubes or flues from 4 to 8 inches in diameter, it may often be difficult to decide which of the two terms is proper to use. When the water and steam is inside the tubes, they are called water tubes. Although the point you have made is well taken, we believe that the boiler to which you refer should be called a vertical water tube boiler.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue.

Gear wheels and g-cutting. Grant, see adv., p. 16.

Link Belting and Sprocket Wheels.

Send for Catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

Link-Belt Engineering Co., Philadelphia and N. Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Duplex Gear Cutters. R. M. Clough, Meriden, Ct.

$1.50 Buys Telgh. Sounder & Key. Lewis, Corry, Pa.

The best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

Berryman Feed Water Heater and Purifier. Benj. F. Kelley, 91 Liberty street, New York.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

Castings for small and medium sized vertical engines. Humphrey's Foundry, Bellefontaine, O.

"Swift" Sight Feed Lubricator; no glass tubes; simple, reliable. Swift Lub'r Co., Elmira, N. Y.

Power measured with guaranteed Dynamometers. Franklin Van Winkle, 91 Liberty st., New York.

New Catalogue of Screw Plates, Taps, Dies, etc., just issued by S. W. Card & Co., Mansfield, Mass.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Common-sense oil filters are a wonder. They repay cost quickly. C. F. Baker, Minneapolis, Minn.

Fire Brick and Clay Retorts; large variety; special shapes to order. Borgner & O'Brien, Philadelphia.

"The Bulldozer," a new departure; forging by pressure. M'f'd by Williams, White & Co., Moline, Ill.

Ice and Refrigerating Machines, 131 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

"How to Keep Boilers Clean." A 96 page book mailed free by Jas. E. Hotchkiss, 120 Liberty st., N. Y.

Selden Packing, for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Brown & Sharpe Mfg. Co., have a line of machinery with S. A. Smith, 23 S. Canal st., Chicago, Ill.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Engine lathes, hand lathes, fine tools, files and supplies for machinists and other metal workers. Frasse & Co., 92 Park Row, N. Y.

Upright drills, improved, sizes 21", 23", 25", 28", 32", 36" swing; finely made and great capacity. Currier & Snyder, Worcester, Mass.

Split Pulleys at low prices and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See Feb. 14, p. 15. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Fine tools and supplies for machinists and other metalworkers. Get our prices before purchasing elsewhere. Montgomery & Co., 105 Fulton st., N. Y. City.

See illustration of improvements in Hooks for Steam Engines, in Nov. 24 issue. For particulars address T. C. Dill Machine Co., 726 Girard av., Phila., Pa.

The Holly Manufacturing Company, of Lockport, N. Y., will send, on application, their pamphlet illustrating pumping machinery and reports of duty trials.

With my System, Exhaust Steam Heating costs nothing for fuel; Live Steam Apparatus altered to Exhaust. Satisfaction guaranteed. Geo. A. Barnard, 15 Cortlandt street, New York.

W. H. Hoffman, consulting engineer, 108 Liberty st., room 3, N. Y. Mechanical engineering in all its branches, working drawings for the transmission of power by steam, water, air and electricity.

Contract work of all kinds executed promptly and on reasonable terms. Parties wishing grey iron castings in large quantities can make money by corresponding with Rawson Mfg. Co., Hornellsville, N. Y.

The Vance Lightning Flue Cutter is *the* tool for removing old flues from boilers and locomotives (will cut fifty an hour); sent on approval to railroad companies. Vance Tube Cutter Co., Geneva, N. Y.

A system of easy lettering, by J. H. Cromwell, giving 26 forms of alphabets. The space to be lettered being divided into squares; simple and effective. Price 50 cents. Catalogue of books for engineers free. E. & F. N. Spon, 12 Cortlandt st., N. Y.

Special facilities for the manufacturing of all kinds of light machinery, hardware and novelties, by contract or otherwise. Presswork and stamping done on short notice. Estimates furnished. Punches, dies and special tools made when required. Rockaway Mfg. Co., 3 E. 14th street, N. Y.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

"Practical Drawing." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including Feb. 14, 1889 issue, 70 articles have been so far published. Copies containing these articles sent by mail to any part of this country or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

"Modern Locomotive Construction." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 84 articles have thus far appeared up to and including the Feb. 7, 1889 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

MANUFACTURES.

A company has been organized at Decatur, Ala., to build gas works.

A. Reynolds & Son will build an addition to their machine shop, at Macon, Ga.

Charles H. Carlisle is interested in building an iron foundry at Spartanburg, S. C.

The Camden Woolen Co., Camden, Me., expect to build a woolen mill in the spring.

J. E. Cox is building a machine shop at High Point, N. C. The shop will be 30x70 feet.

Thomas Kane & Co., Chicago, Ill., have brought out an automatic cut-off engine, for which crude oil is used as fuel.

The South Baltimore Car Works, Baltimore, Md., are building a foundry 84x220 feet. The foundry is to be used for making car wheels.

The Old Colony Railroad Co. will complete their shops at Braintree, Mass., early in the summer. They will expend $200,000 in building the shops.

The Skinner Chuck Co., New Britain, Conn., have increased their capital stock from $12,000 to $36,000. This was rendered necessary by their constantly increasing business.

Greenlee Brothers will build a shop for the manufacture of wood-working machinery at 227 West Twelfth street, Chicago, Ill. The factory will be 75x140 feet, four stories high.

A large mill will be erected at Manchester, N. H., by the Manchester Mills management. It is to be five stories in height, 140 feet long, and 55 feet wide, and will be devoted to weaving purposes.

Elmer E. Cline, Alliance, Ohio, is successor to L. D. Cline, and manufactures engines and boilers for stationary and marine purposes; also pottery wheels, injectors, speed lathes, shafting, hangers, etc.

The Utica (N. Y.) Steam Engine Works' foundry has been sold to the Carlton Furnace Company, of that city. This will double the Carlton Co.'s capacity, and give it the largest moulding room in the State.

The Woodward Electrical Company, Detroit, Mich., send us a catalogue, descriptive of the storage battery which they furnish. The catalogue contains a good deal of information in relation to electrical terms, etc.

Miller, Metcalf & Parkin, Pittsburgh, Pa., have added a dining room to their works, where workmen can obtain a "square meal" at cost. Looking over the cost of a full meal, as given in the Pittsburgh *Gazette*, we should say that the day of the dinner pail had gone by in that establishment.

A new manufacturing corporation, known as the Faulkner & Colony Manufacturing Company, has been incorporated at Keene, N. H., with a capital stock of $100,000. The new corporation takes all the property heretofore owned by Faulkner & Colony, and the business will be carried on as heretofore.

J. D. Flint and others are organizing a stock company to build a new cotton mill in Fall River, Mass. The capital stock is to be $400,000, and about $300,000 has already been subscribed. Among the large stockholders there are said to be John D. Flint, Reuben and Thomas Hargraves, Fales & Jencks, of Pawtucket, and others.

The Hartford (Conn.) Steam Boiler Inspection and Insurance Co. has issued, for free circulation, a pamphlet entitled, "Some Recent Boiler Explosions, and Short Talks to Steam Users." The pamphlet is illustrated with representations of boiler explosions, and contains, besides, much information of value to engineers and boiler owners.

An immense rolling mill will likely be built at McKeesport, Pa., in the spring. A company has been formed by Pittsburgh, New York and Philadelphia capitalists, who propose to engage in the iron business, and a committee has been appointed to look for a site. This committee has selected McKeesport, and secured a ten days' option on ten acres of ground in that town.

A Muncie (Ind.) dispatch is to the effect that Ex-Governor Leon Abbett, of New Jersey and a party of New York capitalists have perfected the organization of a company representing $2,000,000 capital. They have purchased 2,000 acres of land adjoining the city, on which they will erect factories to be run by natural gas. A plant employing 2,800 men will be erected.

There is water-works agitation in Marion, Ala.; Fernandina, Fla.; Georgetown, Ky.; Madison, Neb.; Wytheville, Va.; Dayton, Ohio; Elgin, Ill.; London, Ohio; South Denver, Col.; Attica, Kan.; Rochester, Pa.; Ironton, Ohio; Lafayette, Ohio; Medicine Lodge, Kan.; Grand Rapids, Mich.; Port Townsend, W. T.; Anaconda, Mont.; Gilroy, Cal.; Los Angeles, Cal.; Minden, Neb.; Portland, Conn.

Extensive bridge works are to be built at Elmira, N. Y. The company has been incorporated by Charles Kellogg, W. Hauxhurst, W. S. McCord, Robert Grimes and John C. Wellis, and will have an office in New York, which will be the headquarters for Mr. Hauxhurst. Mr. Kellogg was for years at the head of the great bridge works at Athens, Pa., and is known far and wide as one of the best men in the business.

It is stated that an effort is now being made in New York to form a syndicate for the construction of a pipe line from the Wyoming oil fields in the Big Horn country to a point near the Northern Pacific Railway. It has been intimated that the Northern Pacific Railroad is interested in the organization of this pipe line syndicate, the object being to shut out the Union Pacific and its connection with the Billings, Clarke's Fork and Cooke City Line, which proposes to penetrate this oil region.

Special meetings of the stockholders of the Chace Mills and the Richard Borden Manufacturing Company, Fall River, Mass., have been called to take action on propositions to increase the capital stock of these corporations and build new mills. It is proposed to raise the capital of the Chace mill from $500,000 to $750,000, and build a mill of 30,000 spindles. The proposition to be submitted to the stockholders of the Richard Borden mill is to wipe out the debt of the concern by reducing the capital from $900,000 to $650,000, and reducing the number of shares from 9,000 to 6,500, and then issue new stock to bring the capital up to $900,000 again, and build a new mill.

Manning, Maxwell & Moore, New York, write us: As a matter of news item, we presume you will be pleased to notice that Mr. T. W. Welsh, Superintendent of The Westinghouse Air Brake Co., left here Saturday, having placed his order with us for 214 twenty-one-inch lathes for the new shops of The Westinghouse Air Brake Co., now being constructed. This is probably the largest order ever placed in this country for this class of machine tools, and we feel much gratified at the fortunate result of our competition, because of the very exacting requirements of the Westinghouse people for the highest standard of tools, and our securing the order entirely on the merits of our tools.

The Blakeney Foundry Company has very recently added to its foundry a machine shop. Twelve practical machinists are employed, and the venture has been a most successful one. It was entirely an experiment, and so well pleased with it is the firm, that they are likely to increase their facilities. The work is on drill presses. Outside of this department there are about 75 men in the foundry, working 10 hours a day. This is a full complement, and the 10 hours has been in vogue all winter, something unusual. Orders enough are booked to keep the foundry going all summer. The increased facilities give the firm a wide range, and allow booking of large orders.—*Springfield* (O.) *News.*

The following New Haven (Conn.) dispatch appears to contradict an opinion that has generally prevailed: It is authoritatively announced that the land recently purchased by the Standard Oil Company in this city and Waterbury will not be utilized for the location of oil refineries, as was at first supposed. No crude oil will be brought into Connecticut for refining purposes. The land will be used simply for the erection of distributing stations, in order that customers may be supplied with oil without the necessity of it passing through jobbers hands. It is stated that the Standard Oil Company had three years ago a surplus stock of 40,000,000 barrels, which has since been reduced to 16,000,000 barrels. Anticipating a possible scarcity of oil, it is said the company is preparing facilities by means of which it can deliver the commodity to consumers at the lowest possible expense.

Machinists' Supplies and Iron.

NEW YORK, Feb. 16th, 1889.

Iron—American Pig. There has been no perceptible improvement in the general condition of the market. Though a large business is done in the aggregate, yet the productions are in excess of the demand, and some furnaces have gone out of blast. We quote No. 1 X Foundry, $17.50 to $18; No. 2 X, $16 to $17, and Grey Forge, $15 to $15.50.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Wanted—See bottom of third column, page 11.

Wanted—By a practical machinery pattern maker, position as foreman. Box 819, Hartford, Conn.

Draftsman of 15 years' experience, steam engines and general mach. wants position. W. 7., AM. MACH.

Wanted—Position as drafts'n or foreman machinist by pract'l young man. O., AMERICAN MACHINIST.

Situation as assistant draftsman wanted by a young man, graduate of technical school in Sweden. K. G., AMERICAN MACHINIST.

Wanted—By a first-class brass moulder a position as foreman, or to work at trough or on floor. Address W. X., AMERICAN MACHINIST.

A competent practical foundry man wants a position as foreman; capable of producing the best results. Address Y. Z., AMERICAN MACHINIST.

Wanted—Machine shop foreman; principal work marine engines; state age, nativity, experience, and salary expected. Machine shop, AM. MACHINIST.

Situation wanted by a technical school graduate with experience as machinist and draftsman; intelligent and energetic. P., AMERICAN MACHINIST.

Experienced Foundry Foreman desires position, or will enter into a contract to make work by the ton. Heavy mach. preferred. Box 64, AM. MACHINIST.

Mech'l draftsman (age 22), graduated in a German technical college, several years practical experience on lathe and vise, wants employment. Salary 9 dollars weekly. C. Ferrari, 508 N. 3d St., Phila., Pa.

Wanted—By a practical foundryman with some means, to communicate with some responsible party with regard to engaging in such business in some good locality, or good position as foreman. Address Energy, P. O. Box 262, Columbus, Ga.

Two mechanical engineers, fitted by technical education and practical experience to take charge of machinery exhibit, would like to correspond with parties contemplating an exhibit at Paris Exposition, with view to taking charge of same. Address S. L., care AMERICAN MACHINIST.

Wanted By a first-class machinist, position as foreman, where ability will count; experienced at heavy hydrostatic machinery, marine, stationary and blowing engines; good draftsman; can handle men to best advantage; heavy work preferred. Address Competent, AMERICAN MACHINIST.

Practical business man (age 40) seeks engagement. Experiences—marine, stationary, printing press, shoe, brick and general machinery. Good designer and draftsman, progressed through each department; accustomed to monthly and quarterly balance sheets showing the results of each department. Many years in business. Further particulars of F. Myers, 269 Webster st., East Boston, Mass.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Crescent steel tube scrapers are unquestionably the best. Crescent Mfg. Co., Cleveland, O.

Crescent boiler tube cutter, for setting new and removing old tubes. Crescent Mfg. Co., Cleveland, O.

Machinists.—Increase your income without capital or risk. See page 14, column 1.

Light and fine machinery to order; Foot Lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

August C. Christensen, 24 State St., N. Y., consulting engineer for hydr. and pumping machinery, etc.

Punches, Dies and special machinery built to order. C. F. Langston & Co., 70 N. 4th st., Phila., Pa.

The patent on scale for measuring pipe and fittings, as shown in AMERICAN MACHINIST, Jan. 24, is for sale. W. L. Cheney, Hartford, Conn.

Wanted—Two or three steam specialties to handle exclusively, by party who will give them his whole attention. Address Specialties, AM. MACHINIST.

Roper's Engineer's Handy-book, the best book ever published for Engineers. Post free, $3.50. Send for list. Thos. Ordish, 1723 S. 7th st., Phila., Pa.

Wanted—One second-hand Corliss Engine, 75 to 80 h. p. Delivery not later than May 1. Address with full particulars and price, Tim & Co., Troy, N. Y.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

Wanted—To buy second-hand lathes, planers and shapers of all sizes; must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati, O.

The owners of Patents for the manufacture of improved Cast-iron Pulleys by a method that reduces the cost 40% below present processes propose to license a few parties to manufacture. Correspondence solicited. Address "Pulley," AM. MACHINIST.

TO
CIVIL, MECHANICAL & MINING ENGINEERS,
ARCHITECTS, BUILDERS, MANUFACTURERS, &c., &c.
OUR COMPLETE CATALOGUE of SCIENTIFIC and INDUSTRIAL WORKS will be sent FREE by Mail on application.
JOHN WILEY & SONS, Astor Place,
NEW YORK.

BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER
ESTABLISHED 1832
Combines the best elements essential in a first-class Hammer. Has more good points, does more and better work and costs less for repairs than any other Hammer in the world.

BRADLEY'S HEATING FORGES.
ESTABLISHED 1832
With a manufacturing experience of over half a century, we recommend these machines to be the best, simplest, most durable and combining all the essential elements. For hard coal or coke. Indispensable in all shops. Keep Bradley's Cushioned Hammers and men fully employed and reduces cost of production.
Pat. Aug. 30, 1887.
BRADLEY & CO.
SYRACUSE, N. Y.
98 Sudbury St., Boston, Mass.
63 Murray St., New York.

THE HUSSEY RE-HEATER
RE-HEATS EXHAUST STEAM.
Super-Heats Live Steam,
Heats Air or Water
WITHOUT COST.
The Hussey Re-Heater and Steam Plant
IMPROVEMENT CO.
A. S. HATCH, President.
S. D. BREWER, Gen'l Manager.
15 Cortlandt St., N. Y.

TANITE
EMERY WHEELS and GRINDING MACHINES.
FOR SAW MILLS, FOUNDRIES AND MACHINE SHOPS
For Circulars address
THE TANITE COMPANY, STROUDSBURG, MONROE CO., PA.
Or H. A. ROGERS, 19 John St., N. Y.

Bridgeport Machine Tool Works,
E. P. BULLARD, PROP.
BRIDGEPORT, CONN.
37 & 51 INCH BORING & TURNING MILLS,
LATHES, SCREW MACHINES, TURRET MACHINES, &c.

W. C. YOUNG & CO., Worcester, Mass
Manufacturers of
Engine Lathes, Hand Lathes,
FOOT POWER LATHES, SLIDE RESTS, ETC.

THE DEANE STEAM PUMP CO.,
HOLYOKE, MASS.,
New York, Boston, Chicago, Philadelphia
St. Louis,
Manufacturers of
STEAM and POWER
PUMPS
FOR ALL PURPOSES.
SEND FOR CATALOGUE.

ENGINE LATHES.
THE HENDEY 18-INCH ENGINE LATHE
Combines modern design with superior workmanship at a moderate price. No extra charge for Compound Rest, Hollow Spindle or Power Cross Feed. Length of beds, 6, 8, 10, 12, 14 and 16 feet. Have other sizes of Lathes; also, Shapers, Planers, &c. Send for Catalogue and Prices.
THE HENDEY MACHINE CO.,
TORRINGTON, CONN.

MUCH TIME AND LABOR NOW LOST
At the grindstone or tool fire can be saved by using our "CRESCENT EXTRA" Steel for Machine Shop Tools and Dies doing hard work. Always specify it in your orders.
MILLER, METCALF & PARKIN,
CRESCENT STEEL WORKS.
CHICAGO, Ills. PITTSBURGH, PA. NEW YORK, N. Y.

Sebastian, May & Co.'s Improved Screw Cutting
FOOT AND POWER LATHES
$175. $60
Drill Presses, Shapers, Band, Circular and Scroll Saws. Machinists' Tools and Supplies. Lathes on trial. Catalogue mailed on application.
167 West Second Street, CINCINNATI, O.
OUR SPECIALTIES, 8, 12, 14 and 18 inch Lathes.

STEPHENS' PATENT VISES.
QUICK-ADJUSTING CAM AND TOGGLE JOINT.
Stationary or Patent Swivel Bases.
INCOMPARABLE FOR STRENGTH, DURABILITY FIRM HOLD AND QUICK WORK.
Has improved Taper, Pipe and other attachments. Made in 2, 2¾, 3½, 4½, 5½, and 6½ inch width of jaw.
Sold by the Trade. Send for Circular.
TOWER & LYON, MFR'S,
95 CHAMBERS ST., NEW YORK.

FINE TAPS, DIES, REAMERS, ETC.
GREEN RIVER PAT. SPIRAL FLUTED
LIGHTNING AND GREEN RIVER SCREW PLATES.
Bolt Cutters, Hand and Power Drilling Machines, Punching Presses, Tire Benders, Tire Upsetters and Other Labor-Saving Tools. Send for Price List.
WILEY & RUSSELL MFG. CO., GREENFIELD, MASS.

TO MANUFACTURERS!
Wood Working Machinery Plant
FOR SALE.
Situated in a live manufacturing city in New England, now doing a very profitable business—sales about $36,000 a year. The Tools, Patterns, Good Will, Stock, and Machines on hand will be sold. No machines have a better reputation than those manufactured by this company. A full line of wood working machinery has been and can be made in the shops. Two lines of railroad ensure cheap freight rates. The reason for selling is too much other business that cannot be relinquished. Full particulars on application.
B. G. UNDERWOOD,
31 Pemberton Square, BOSTON, MASS.

ROSE POLYTECHNIC INSTITUTE,
TERRE HAUTE, IND.—A SCHOOL OF ENGINEERING.
Well endowed, well equipped departments of Mechanical and Civil Engineering. Electricity, Chemistry, Drawing. Extensive Shops & Laboratories. Expenses low. For cat'gue address T. C. Mendenhall Pres.

IF YOU WANT A STRONG, ECONOMICAL
ENGINE
EITHER HORIZONTAL OR VERTICAL,
FOR STEADY EVERY DAY AND ALL NIGHT SERVICE AND AT A LOW PRICE, WRITE TO
COOKE & CO., 22 Cortlandt St., New York.
Twelve Hundred Engines in use.
Please mention this paper.

$75
"Star" Foot Lathe Swings 9x25 in.
LATHE
Screw Cutting Automatic Cross Feed, etc.
Scroll Saws, Circular Saws, Lathes, Mortisers.
Catalogue Free of all our Machinery
Seneca Falls Mfg. Co. 687 Water St., Seneca Falls, N.Y.

KNOWLES Steam Pump Works.
93 Liberty St., NEW YORK. | 113 Federal St., BOSTON.
IMPROVED PUMPING MACHINERY | For Every Class of Work | Send for New Illustrated CATALOGUE.

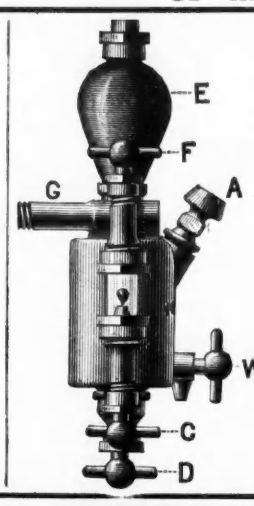
BORING AND TURNING MILLS
MADE BY
BETTS MACHINE CO.,
Wilmington, Del.
From JONES & LAUGHLINS,
PITTSBURGH, PA.
"The 5 Foot Boring and Turning Machine which you shipped to us in August last, performs its work very satisfactorily."
April 21, 1888. T. M. JONES, Gen. Man.
SIZES.
5, 6, 7, 7-10, 8, 9, 10, 10-16, 12, 14, 14-20 ft.

NICHOLSON FILE COMPANY,

PROVIDENCE, R. I.

Files and Rasps.

In magnitude, variety and excellence of product, this company has no equal in this, or any other country.



THE "VOLUNTEER"
UP-DROP, SIGHT FEED, LUBRICATOR,

(GATES PATENT.)

FOR STATIONARY ENGINES AND PUMPS OF ALL KINDS. LUBRICATORS FOR SINGLE OR DOUBLE CONNECTION.

PRICE LIST.

Nos.	1	2	3
Price	$10.00	$12.00	$15.00
Capacity	½ pt.	½ pt.	¾ pt.

NATHAN MANUFACTURING CO.,
92 & 94 LIBERTY STREET, NEW YORK,

Send for Catalogue. SOLE MANUFACTURERS.

HOWE, BROWN & CO., Limited,

ESTABLISHED 1859.
Formerly HUSSEY, HOWE & CO., Limited.
PITTSBURGH, PA.

Manufacturers of all kinds

CRUCIBLE AND OPEN HEARTH STEEL, CAMERON SELF-HARDENING STEEL,

For Shearing Tools and Turning Steel Tires.

BRANCH OFFICES: Boston, 127 Oliver St. New York, 12 Cliff St. Chicago, 171 La Salle St.

Established in 1874.

CLEVELAND TWIST DRILL CO.

Corner Lake & Kirtland Sts., Cleveland, O.
101 Chambers Street, New York.
85 Queen Victoria St., London, Eng.

JUST PUBLISHED.

BOILERS:

Including Rules, Formulæ, and Tables for the Construction of Boilers, Safety Valves, Material for Boilers, Tables of Areas, &c.

Arranged in a Convenient Form for the Use of Engineers, Inspectors, Surveyors, Draughtsmen, Boiler-Makers, and Steam-Users.

By THOMAS W. TRAILL, F. E. R. N., M. Inst. C. E.
Engineer Surveyor-in-Chief to the Board of Trade.

*** The Tables are all Original, and have been specially calculated and arranged for this Work.

12mo, cloth, 432 pages. Price $3.50.

Postpaid on receipt of price.

D. VAN NOSTRAND CO.,
PUBLISHERS AND BOOKSELLERS,
23 Murray and 27 Warren Streets,
NEW YORK.

Root's Force Blast Rotary Blower.

FOR

FOUNDRIES, SMITH SHOPS, PNEUMATIC TUBES, VENTILATION, ETC.

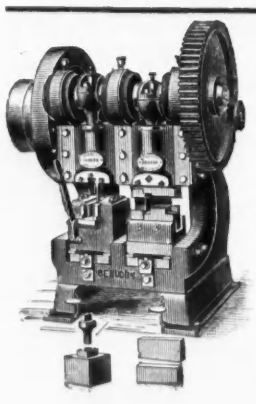
SLOW SPEED, POSITIVE BLAST, PERFECTLY BALANCED.

Best Mechanical Construction.

P. H. & F. M. ROOTS, Manufacturers,
CONNERSVILLE, IND.

S. S. TOWNSEND, Gen. Agt. } 22 Cortlandt St.,
COOKE & CO., Selling Agts. } NEW YORK.

In Writing, Please Mention This Paper.



BEAUDRY'S DUPLEX Power Press

COMBINING
PRESS, SHEARS AND PUNCH.

BEAUDRY & CO
(Formerly of Beaudry's Upright Power Hammer.)
Sole Manufacturers.
Also manufacturers of
HARD COAL HEATING FORGES.
Room 4, MASON B'DG,
70 KILBY ST.,
Boston, Mass.

MONTGOMERY & CO.,
105 FULTON ST., NEW YORK,

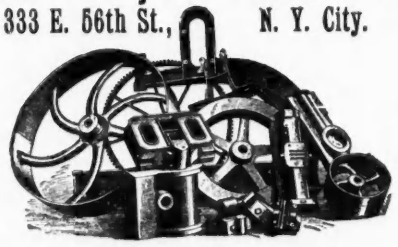
TOOLS, SUPPLIES AND MACHINERY

FOR ALL BRANCHES OF THE MECHANICAL TRADES.

Illustrated Catalogue (300 pages) mailed on receipt of Fourteen Cents.

Iron Foundry of T. Shriver & Co.,

333 E. 56th St., N. Y. City.



Nice Castings, Smooth and True to Patterns, of very best brands of Pig Iron.

CASTINGS IN QUANTITY AT FAVORABLE PRICES.

HENRY CAREY BAIRD & CO.,

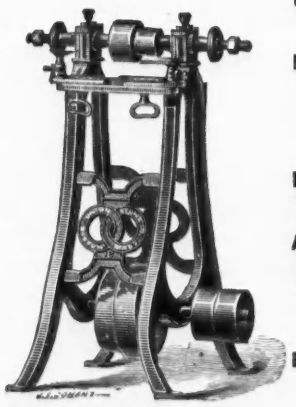
Industrial Publishers, Booksellers and Importers.

810 Walnut St., Philadelphia.

☞ Our New and Revised Catalogue of Practical and Scientific Books, 80 pages, 8vo., and our other Catalogues and Circulars, the whole covering every branch of Science applied to the Arts, sent free and free of postage to any one in any part of the world who will furnish his address.

UNION STONE COMPANY,

38 & 40 HAWLEY ST., BOSTON, MASS.
36 JOHN ST., NEW YORK.



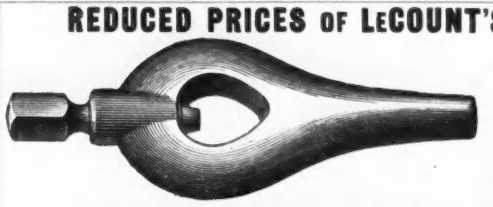
EMERY OR CORUNDUM WHEEL GRINDING MACHINERY, EMERY OR CORUNDUM WHEELS AND TOOLS.

MACHINERY FOR POLISHING WHEELS, POLISHING BELTS, AND POLISHING BUFFS, AND ALL SUPPLIES PERTAINING THERETO.

ELECTRO-PLATERS' SUPPLIES.

B. GRINDING MACHINE.
1" Shaft. Takes Wheels to 14" diameter. Countershaft with hangers or in machine. Is specially adapted to light work in machine shop, tool grinding, etc.

REDUCED PRICES OF LeCOUNT'S STRAIGHT TAIL DOG.

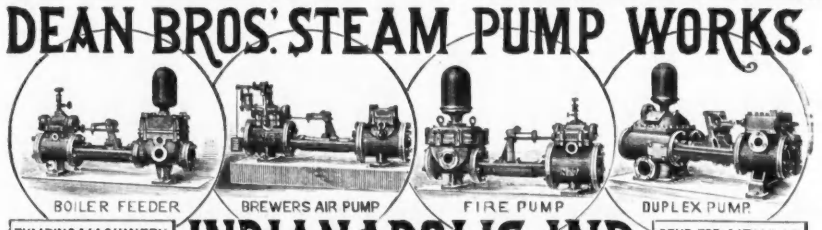


To be driven from a Stud in the Face Plate.

No.	INCH.	PRICE.	No.	INCH.	PRICE
1	¾	$0.60	10	2¾	$1.35
2	⅞	.70	11	2½	1.45
3	1	.70	12	3	1.60
4	1⅛	.80	13	3½	1.80
5	1¼	.80	14	4	2.10
6	1⅜	.95	15	4½	2.75
7	1½	.95	16	5	3.25
8	1¾	1.10	17	5½	4.00
9	2	1.20	18	6	5.00
1 Set to 2 in.		7.80	Full Set		31.10

C. W. LeCOUNT, South Norwalk. Conn.

DEAN BROS. STEAM PUMP WORKS.



PUMPING MACHINERY FOR ALL PURPOSES.

INDIANAPOLIS, IND.

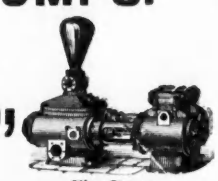
SEND FOR CATALOGUE AND PRICES.

HALL DUPLEX STEAM PUMPS.

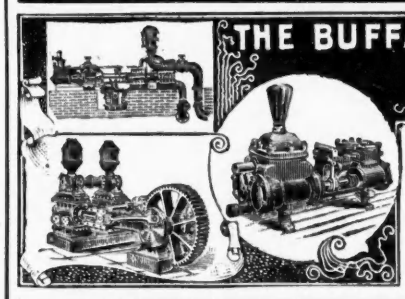
Send for New Catalogue.

Boiler and Pump Combined

HALL STEAM PUMP CO.,
91 Liberty St., New York.



Fire Pump.



THE BUFFALO STEAM PUMP CO.
BUFFALO, N.Y.

E. G. FELTHOUSEN, PRES'T.
D. L. VOLKER, VICE PRES'T.
Wm. H. SHERMAN, SEC'Y.

For Sale at Factory Prices by

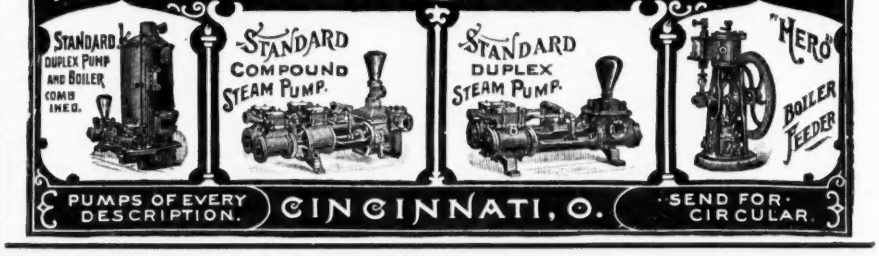
A. Aller, New York; Walworth Construction and Supply Co., Boston, Henry I. Snell, Philadelphia; Thos. J. Bell & Co., Cincinnati; Shaw, Kendall & Co., Toledo; The George Worthington Co., Cleveland; Goulds & Austin, Chicago; Kennedy & Pierce Machinery Co., Denver, Col.; Sheriff & Ashworth, Pittsburgh, Pa.; Jos. Baur, Manistee, Mich.; Jas. Jenks, Detroit; Wickes Bros., East Saginaw; Adolph Leitelt, Grand Rapids; E. F. Osborne & Co., St. Paul, Minn.; Rundle, Spence & Co., Milwaukee; Joshua Hendy Machine Works, San Francisco; Flynn & Emrich, Baltimore; Forbes, Liddell & Co., Montgomery, Ala.; Bailey & Lebby, Charleston, S. C.; Pond Engineering Co., St. Louis and Kansas City; O. B. Goodwin, Norfolk, Va.; Columbus Supply Co., Columbus, O.; C. S. Leeds & Co., Minneapolis; H. D. Coleman, New Orleans.

GUILD & GARRISON,

Kent Ave. and South 10th St., Brooklyn, N. Y.

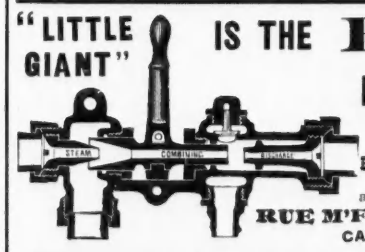
Builders of Steam Pumps, Vacuum Pumps, Vacuum Apparatus, Filter-press Pumps, Air Compressors, Condensers for Pans, Engines, Steam Pumps, Etc.

THE LAIDLAW & DUNN CO.



PUMPS OF EVERY DESCRIPTION. CINCINNATI, O. SEND FOR CIRCULAR.

"LITTLE GIANT" IS THE Best Injector



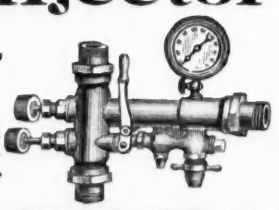
For Feeding all Steam Boilers.

RUE'S EJECTOR,

Superior to all others for Raising and Forcing Water and other Liquids.

Boiler Washer and Testing Device.

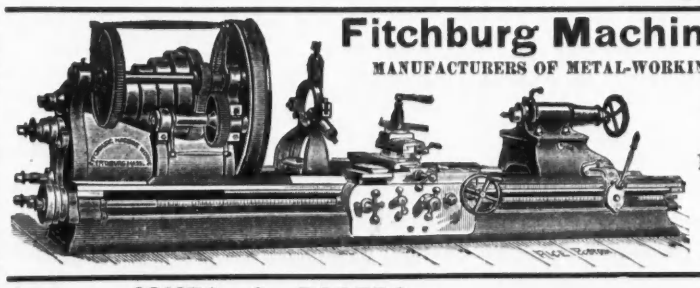
Uses Warm Water, avoiding injury and facilitating the Raising of Steam.



RUE M'F'G CO., PHILA., PA.
CATALOGUES FREE.

Fitchburg Machine Works

MANUFACTURERS OF METAL-WORKING MACHINERY.



OFFICE AND WORKS,
13 to 21
MAIN ST.,
Fitchburg, Mass.

SEND FOR CATALOGUE E.

JONES & ROGERS,

5 West 4th St., Cincinnati, O.,

CONSULTING ENGINEERS.

Machinery Designers.
Standard Drawings Made.
Blue-Printing a Specialty.
WE CAN SAVE YOU MONEY.

We never sleep. WRITE TO US.

BEST PLANE IN THE WORLD.

The Gage Tool Co.'s Self-Setting Plane.

New Madrid, Mo., Aug. 27, '88.

Gage Tool Co., Vineland, N. J.

The planes received O. K. Have tried them thoroughly on hard yellow pine and on cypress knots, which I think are equal to hemlock. This morning, after jointing the edge of a very hard 1 1-4 inch yellow pine board, with a great deal of resin in it, I took the iron of my Fore Plane and *shaved* myself with it, without putting it on the oil stone or sharpening it in any manner. This was done in the presence of 3 (three) witnesses, and if any one wishes verification of this, let them send notary's fee and I will make oath to same.

GEO. H. GLOVER, Contractor and Builder.

ASK DEALERS FOR THEM.

WORTHINGTON
Independent Condenser

ADAPTED TO

STATIONARY AND MARINE ENGINES

SURFACE CONDENSERS

And Vacuum Pans

High Range of Vacuum assured

REGULAR IN MOTION DURABLE AND COMPACT

CORRESPONDENCE DESIRED

HENRY R WORTHINGTON
NEW YORK
BOSTON PHILADELPHIA
CHICAGO ST LOUIS SAN FRANCISCO

Facts:—1889 marks the **30th YEAR** of the life of

THE HARRISON SAFETY BOILER.

The results obtained by many of the largest steam users of the country, who have used thousands of horse-power of them during that length of time, will warrant your investigating their merits when in need of power.

HARRISON SAFETY BOILER WORKS,
Germantown Junction, Philadelphia, Pa.

"STEAM"

A VALUABLE BOOK FOR EVERY STEAM USER AND ENGINEER.

PUBLISHED FOR FREE DISTRIBUTION, BY

THE BABCOCK & WILCOX COMPANY,

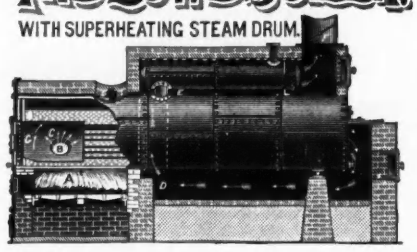
MANUFACTURERS OF

WATER-TUBE BOILERS,

107 Hope St., Glasgow. 30 Cortlandt St., N. Y

THE LOWE BOILER

WITH SUPERHEATING STEAM DRUM.



Over fifty years' competition has proven this system of boiler to be the best in every respect. The **LOWE BOILER**, with all improvements, is the simplest, best wearing and most economical of any kind of fuel.

Send for description and histories of Steam Boilers and Feed Water Heaters (free) to

BRIDGEPORT BOILER WORKS,
BRIDGEPORT, CONN.

Steam Boilers

FOR ALL PURPOSES.

POND ENGINEERING CO.

St. Louis, Mo.

KANSAS CITY, MO. OMAHA, NEB.

THOS. H. DALLETT & CO.
1305 Buttonwood Street,
PHILADELPHIA, PA.
Portable Drills,
Hand Drills,
Boiler Shell Drills,
Light Drill Presses,
Special Machinery.
SEND FOR CATALOGUE.

MACHINIST'S SCALES,
PATENT END GRADUATION.
We Invite Comparison for Accuracy with all others.
EVERY SCALE GUARANTEED. SEND FOR LIST.
COFFIN & LEIGHTON, SYRACUSE, N. Y.

OUR SPECIALTY IS
PLANER VISES AND MEASURING MACHINES.
THE GILKERSON MACHINE WORKS,
HOMER, N. Y.

SEND FOR CATALOGUE.

WORCESTER MACHINE SCREW CO.

Manufacturers of Set, Cap and Machine Screws, Studs, etc.

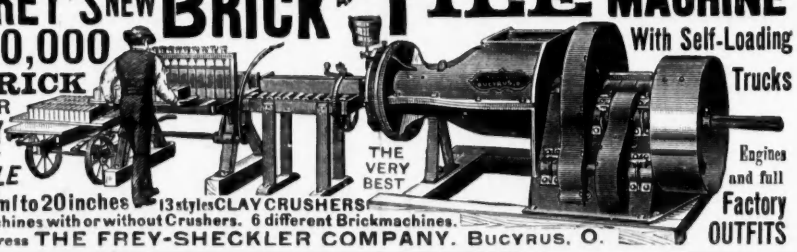
BEVEL GEARS,

Cut Theoretically Correct.
For particulars and estimates apply to
HUGO BILGRAM,
Machinist,
Successor to
BREHMER BROS.
440 N. 12th St., Philadelphia

FREY'S NEW BRICK AND TILE MACHINE

40,000 BRICK PER DAY

TILE from 1 to 20 inches



With Self-Loading Trucks

Engines and full Factory OUTFITS

13 styles CLAY CRUSHERS

Machines with or without Crushers. 6 different Brickmachines.

Address THE FREY-SHECKLER COMPANY. BUCYRUS, O.

"TWENTY YEARS WITH THE INDICATOR."

[PRAY.] Vols. 1 and 2 (one volume.) Seventh thousand. Large 8vo. 285 pp., many illustrations. Price $2.50. JOHN WILEY & SONS, 15 Astor Place, New York.

Sterling Emery Wheel Co.,
Factory, West Sterling, Mas
Office, 17 Dey Street, New York.

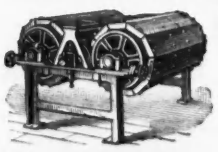
Our Wheels for Machine Shop Work and Tool Grinding Superior to all others.

Send for Catalogue just published.

Chicago Office, 41 South Canal St., Chicago, Ill

ERNEST W. NAYLOR,
CONSULTING ENGINEER, 149 B'way, N. Y.
Designer and Contractor for Hydraulic Plant for Boiler Making, Bridge Building, Goods Sheds and Warehouses, Cranes of all Descriptions. Hydraulic Forging, Flanging, Bending, Armor and Gun Presses, etc.

EXHAUST TUMBLING BARRELS.

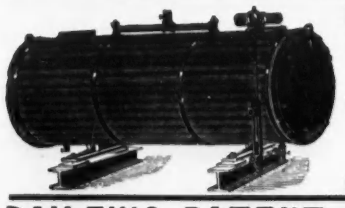


Henderson Bros.
MANUFACTURERS,
WATERBURY, CT.
Send for Circular.

WELDLESS STEEL — QUICK OPENING GATE VALVE — COLD DRAWN TUBES

SMOOTH INSIDE & OUT.

JOHN S. LENG, 4 Fletcher St. N.Y.



The HOPPES Live-Steam Feed-Water Purifier,

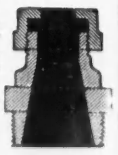
Guaranteed to Prevent Scale in Boilers,
Using any kind of water. Hard Sheet Steel Troughs, *Easily Cleaned.*

HOPPES MANUFACTURING CO.,
Send for Catalogue D. SPRINGFIELD, OHIO.

BAILEY'S PATENT COPPER CAP FUSIBLE PLUG.

A Cheap Means for Preventing Accidents to Steam Boilers through Low Water.

The **fusible metal is kept from contact with the water,** avoiding the chemical and mechanical action, which would otherwise prevent it from melting. Cap is readily removable, permitting free inspection. Highly recommended by the chief Boiler Insurance Companies of Great Britain, over 150,000 being sold in Europe since first introduced, with increasing sales. Also by the U. S. Board of Supervising Inspectors of Vessels at Washington; by Prof. R. H. Thurston, and many other eminent expert engineers, also railway master mechanics, as superior to any now in use, and filling all requirements.



GEO. VAN WAGENEN, Sole American Licensee and Manufacturer.

Illustrated Pamphlets on Application. 233 West Street, New York City.

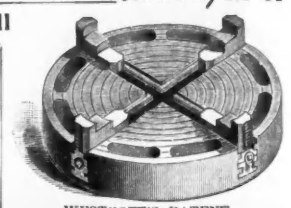
WESTCOTT CHUCK CO., Formerly Oneida Steam Engine & Foundry Co., ONEIDA, N. Y.

Manufacturers of all kinds of Lathe and Drill

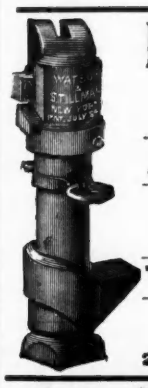
CHUCKS

SEND FOR Catalogue.

Scroll Combination 3 or 4 Jawed. *Jaws reversible.* Diameter.	Capacity.
4 9-16 in.	5 1-2 in.
7 1-2 in.	8 in.
10 1-8 in.	12 in.
13 1-4 in.	15 in.
16 in.	18 in.
18 1-2 in.	21 1-2 in.
21 1-4 in.	26 in.
24 in.	30 in.
30 in.	36 in.
36 in.	43 in.



WESTCOTT'S PATENT.



Hydrostatic Machinery

PRESSES,
PUMPS,
PUNCHES,

ACCUMULATORS,

JACKS,
VALVES,
FITTINGS,

Vault Elevators, &c., &c.

WATSON & STILLMAN,
204-210 E. 43d St., New York.

CHUCKS

WRITE US FOR PRICES.

THE HOGGSON & PETTIS MFG. CO.
Est. 1849. NEW HAVEN, CONN.

INDEPENDENT CHUCKS

(See AM. MACHINIST, Nov. 5, 1887.)

Before buying Chucks of this class, write us for particulars of our latest improvements. Different from other makes, and we claim several points of superiority which we submit to the judgment of mechanics.

THE D. E. WHITON MACHINE CO.,
NEW LONDON, CONN.

DIXON'S

SILICA

Graphite Paint

For Boiler Fronts and Smoke Stacks.

Two coats will last two years. Send for Circular. Equally good for all Iron Work exposed to extreme temperatures, salt air, acid fumes, etc.

Joseph Dixon Crucible Co.,
Manufacturers Pencils and Graphite Specialties.
JERSEY CITY, N. J.

MACHINERY

For Reducing and Pointing Wire.

ESPECIALLY ADAPTED TO POINTING WIRE RODS AND WIRE FOR DRAWING.

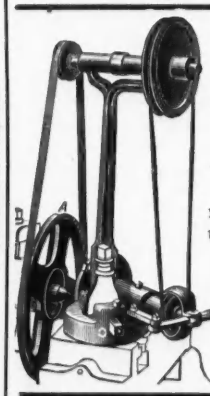
For Machines or information, address the manufacturer,

S. W. GOODYEAR, Waterbury, Ct.

OUR NEW **CATALOGUE OF TOOLS**

And Supplies sent free to any address on receipt of Ten Cents in stamps (for postage.)

Chas. A. Strelinger & Co., WOOD AVE., Detroit, Mich.



LATHE Center Grinder

For trueing **hardened** centers **in place.**

A cheap and effective tool, needed in every well-regulated machine shop.

Write for prices to

TRUMP BROS. MACH. CO.
WILMINGTON, DEL.

TRADE MARK.

THE HORTON LATHE CHUCK!

Manufactured by

THE E. HORTON & SON CO.,
Windsor Locks, Conn., U. S. A.
Send for Illustrated Catalogue.

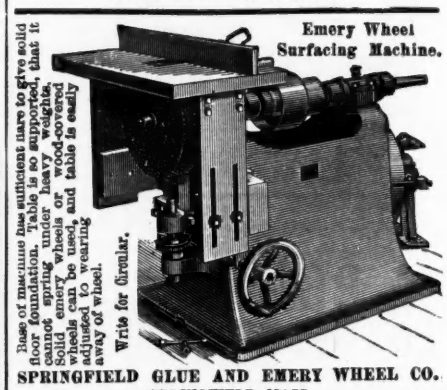
A NEW CATALOGUE OF

CUSHMAN CHUCKS

JUST ISSUED.

Containing new designs. Sizes and prices sent free on application to the

CUSHMAN CHUCK CO.,
HARTFORD, CONN.



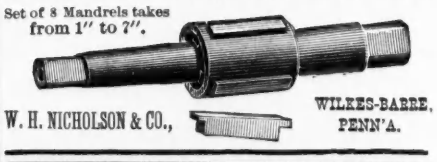
Emery Wheel Surfacing Machine.

Base of machine has sufficient bare to give solid floor foundation. Table is so supported, that it cannot spring. Spindle runs in dust-proof, adjustable boxes. Wheels of any size can be used, and table is easily adjusted to wear of wheel. Write for Circular.

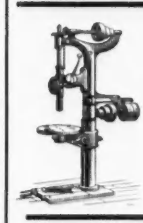
SPRINGFIELD GLUE AND EMERY WHEEL CO.
SPRINGFIELD, MASS.

Save Money by Using
Nicholson's Patent Expanding Lathe Mandrels

Set of 8 Mandrels takes from 1" to 7".

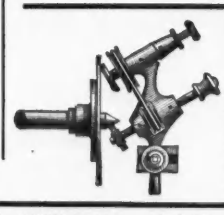


W. H. NICHOLSON & CO., WILKES-BARRE, PENN'A.



DRILLING MACHINES.

ALL STYLES WITH
Latest Designs and Improvements
For cuts and prices, address,
BICKFORD DRILL CO.,
Front & Pike Sts., CINCINNATI, O.



ENERGY MFG. CO.,
1115 South 15th St.,
PHILA., PA.

Sole makers of Rope Hoisting Machines, Drill Guides, etc. Two sizes of Center Grinders, for small and large lathes. Will true up centers quicker than any other device. Send for descriptive circular of specialties.

FRICTION CLUTCH PULLEYS AND CUT-OFF COUPLINGS

JAS. HUNTER & SON,
North Adams, Mass.

HEAVY UNIVERSAL MILLING MACHINE.

For variety and range of work this Machine has no equal, and for workmanship it has no superior.

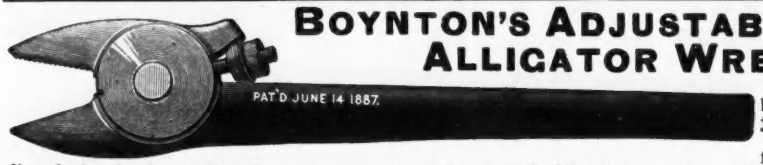
All adjustments have Micrometer dials. Automatic feeds in all directions. Size of Main Journal, 3½"x6". Smaller size built.

PEDRICK & AYER, 1025 Hamilton Street, Philadelphia, Pa.

MORSE TWIST DRILL AND MACHINE COMPANY, New Bedford, Mass.
Manufacturers of **Morse Patent Straight-Lip Increase Twist Drills.**

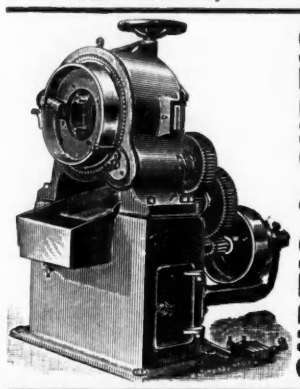
Solid and Shell Reamers, Beach's Patent Self-Centering Chuck, Bit Stock Drills
DRILL GRINDING MACHINES, MILLING CUTTERS AND SPECIAL TOOLS TO ORDER.

BOYNTON'S ADJUSTABLE ALLICATOR WRENCH.

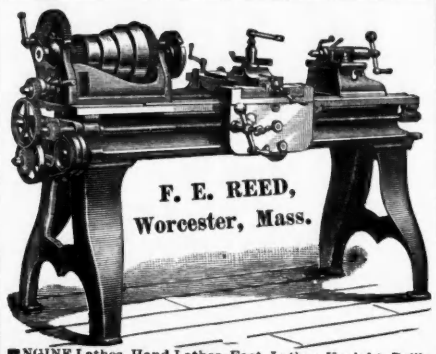


Quick and handy in adjustment. Invaluable for work on clipped pipe, in close coils and corners that cannot be reached with other wrenches. Made entirely of drop forged steel. Six sizes. Manufactured by

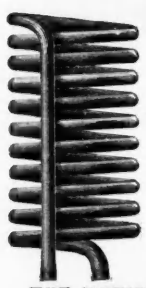
CAMPBELL PRINTING PRESS AND MFG. CO.
160 WILLIAM ST., NEW YORK. **325 DEARBORN ST., CHICAGO.**



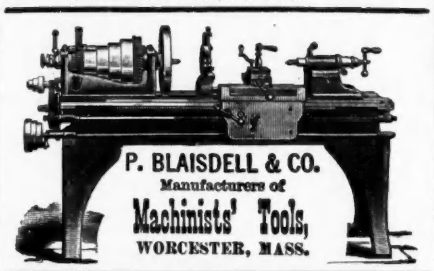
CURTIS & CURTIS,
66 GARDEN STREET,
BRIDGEPORT, - CONN.
Pipe Cutting and Threading Machinery,
FOR HAND OR POWER.



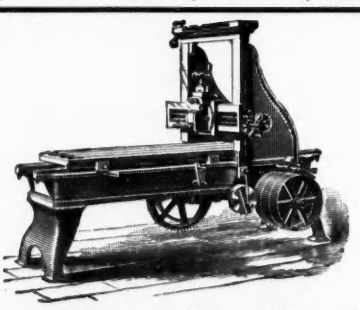
ENGINE Lathes, Hand Lathes, Foot Lathes, Upright Drills, and Milling Machines. Agents, MANNING, MAXWELL & MOORE, 111 LIBERTY STREET, NEW YORK.



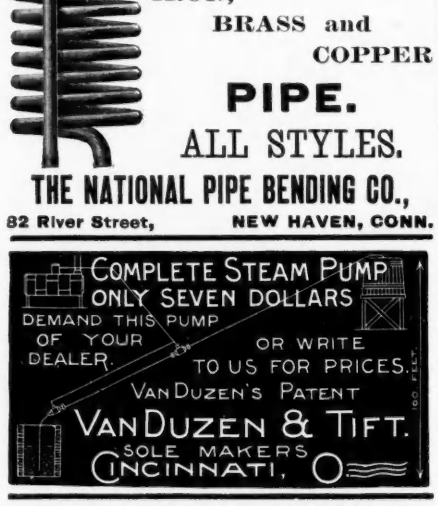
COILS & BENDS
—OF—
IRON,
BRASS and
COPPER
PIPE.
ALL STYLES.
THE NATIONAL PIPE BENDING CO.,
82 River Street, NEW HAVEN, CONN.



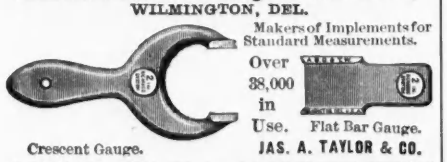
SOLDERING Iron and Steel may be done without causing **RUST**
by using our **Non-Corrosive** Soldering Fluid.
Sample Bottle, prepaid, for 10 cents
FOR SALE BY ALL DEALERS.
STERLING ELLIOTT, NEWTON, MASS.



New Haven Manf'g Co.
NEW HAVEN, CONN.
IRON-WORKING MACHINERY.



American Standard Gauge & Tool Works,
WILMINGTON, DEL.
Makers of Implements for Standard Measurements.



Over 38,000 in Use.

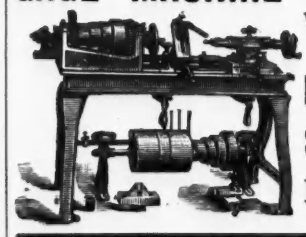
Crescent Gauge. Flat Bar Gauge.
JAS. A. TAYLOR & CO.

PATENT PERFORATED
PLANER BELTING.

PREVENTS AIR CUSHIONS. Guaranteed for work on SIDE CUTTERS and the CYLINDERS of PLANERS.

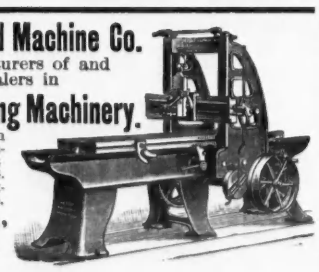
CHAS. A. SCHIEREN & CO., (Manuf'rs.)
45-51 FERRY ST., NEW YORK.
46 SOUTH CANAL ST., CHICAGO.
86 FEDERAL ST., BOSTON.
226 NORTH THIRD ST., PHILA.

Do You use Glue?
Improved Steam Glue Heaters
without joints, and therefore free from leakage. Furnished with plain iron, Enameled iron or Copper Pots. For Pattern Makers, Cabinet Makers, Joiners, Bookbinders, in fact, all who use Glue. Please mention this paper, and send for Price List to makers. Made in nineteen different styles.
PANCOAST & MAULE,
245 South Third Street,
PHILADA, PA.
BUILD THESE



GAGE MACHINE WORKS,
Waterford, N. Y.
Manuf'r's of
FOX, TURRET AND **Speed Lathes** AND **Brass Finishers' TOOLS.**

L. W. Pond Machine Co.
Manufacturers of and Dealers in
Iron Working Machinery.
Improved Iron Planers a specialty. Feed, patented Feb. 9, 1886. Belt Shifter, patented Nov. 2, 1886.
140 Union St., Worcester, Mass.



CARY & MOEN CO.
STEEL WIRE OF EVERY DESCRIPTION & STEEL SPRINGS. 25 E. 14 ST. NEW YORK CITY

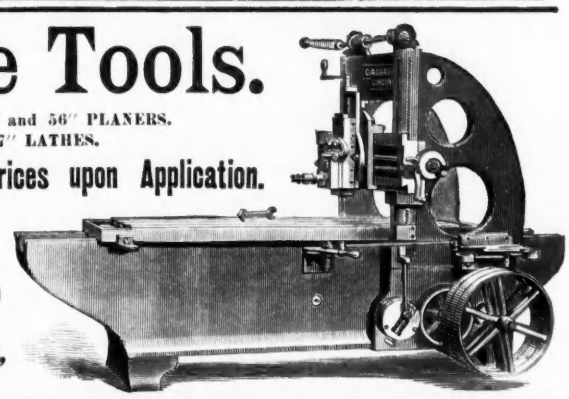
D. SAUNDERS' SONS, Yonkers, N.Y.
MANUFACTURERS OF
Steam & Gas Fitters' Hand Tools.
SEND FOR CIRCULAR.

Pipe Cutting,
THREADING,
AND
Tapping Machines,

THE PATENT WHEEL PIPE CUTTER shown in the cut combines simplicity with strength and lightness. Easily adapted to various sizes of pipe. Rolling instead of sliding motion. No loose parts to become detached and mislaid. All wearing surfaces are of tool steel hardened. Less friction of parts than any other pipe-cutter made.

BUFFALO BLOWERS
FOR CUPOLAS, FORGES, FURNACES &C.
EXHAUSTERS, STEAM FANS
HEATERS & VENTILATING WHEELS.
BUFFALO FORGE CO.
BUFFALO, N.Y.

Machine Tools.
24", 26", 32", 36", 42" and 56" PLANERS.
17", 20" and 27" LATHES.
Catalogue, Photos and Prices upon Application.
THE
G. A. GRAY CO.
477, 479, 481
SYCAMORE STREET,
CINCINNATI, OHIO.

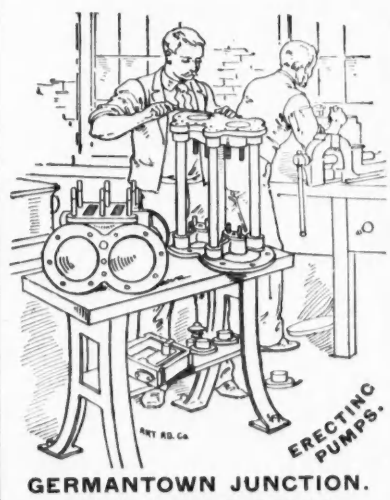


FORGING AND WELDING BY PETROLEUM AIR BLAST FIRES.
THE AERATED FUEL COMPANY,
J. H. BULLARD, GENERAL MANAGER. SPRINGFIELD, MASS.
REPRESENTED BY
W. S. COLLINS, 171 B'way, N. Y. (Suite 24). HARRIS & COWDERY, Ashtabula, Ohio.
ALDEN SPEARE'S SONS & CO., 3 Central Wharf, Boston. I. C. HOWES, Kansas City, Mo.
WILLIAM PICKETT, SON & CO., 170 Lake Street, Chicago, Ill., and St. Louis, Mo.
CHILION JONES, Gananoque, Canada. DUNKIRK ENGINEERING CO., Dunkirk, N.Y.
BRADLEY & COMPANY, Syracuse, N. Y. J. M. DAVIDSON, Columbus, Ohio.
KALAMAZOO SPRING AND AXLE COMPANY, Kalamazoo, Mich.

Brass Melting Furnace.

IF YOU ARE INTERESTED IN **PATENTS** SEND FOR PAMPHLET No 2, FOR MECHANICS & INVENTORS.
J. B. CHAMBERLAIN, SOLICITOR OF PATENTS. 500 5TH ST. WASHINGTON, D. C

DROP FORGINGS.
SEND FOR PRICES.
WYMAN & GORDON,
Worcester, Mass.



BARR PUMPING ENGINE CO
GERMANTOWN JUNCTION.
PHILADELPHIA
DUPLEX PUMPS ALL SIZES. EVERY SERVICE

SHAPING MACHINES
FOR HAND AND POWER.
6", 8" and 10" Stroke.
Adapted to All Classes of Work to their Capacity.
Circulars Furnished.
BOYNTON & PLUMMER,
WORCESTER, MASS.

HODGE'S
Universal Angle Union
PATENTED.
Combining an elbow and union, and can be set at any angle at which it is desired to run the pipe.
Manufacturers & Wholesale Agents,
ROLLSTONE MACHINE CO., 45 Water St., FITCHBURG, MASS.

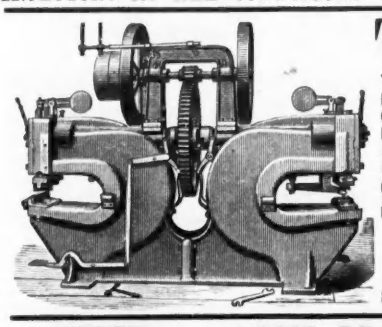
WILLIAM BARKER & CO.,
Manufacturers of
Iron and Brass Working
MACHINERY
140 & 142 E. Sixth St., Near Culvert,
CINCINNATI, O.

L. S. STARRETT,
Manufacturer of
FINE TOOLS,
ATHOL, MASS.
SEND STAMP FOR FULL LIST.

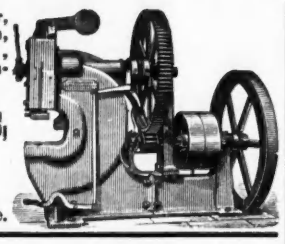
Patent CALCULATOR, For Engineers.
Mechanical. Marine. Electrical. Mining. Hydraulic. Heating. Sanitary. Military.
Naval Constructors Architects. Builders. Mechanics. Assayers. Chemists. Scientists. Students.
Size 10x3¾x1⅛ in. Complete pocket book. All practical problems solved at sight. Mailed on receipt of 75 cents.
R. C. SMITH, No. 1 Broadway, N. Y.

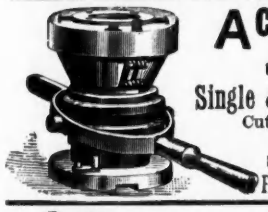
STEAM PUMPS
Should always have some kind of a regulator applied to them, depending on the kind of service they are used in. We make all kinds of regulating specialties. Address
MASON REGULATOR CO., BOSTON,
OR
JENKINS BROS., AGENTS, NEW YORK, PHILADELPHIA & CHICAGO.

WILLIAM SELLERS & CO., Incorporated.
PHILADELPHIA, PA.
BUILDERS OF
MACHINE TOOLS FOR WORKING IRON AND STEEL,
Improved TURNTABLES for LOCOMOTIVES, CARS and PIVOT BRIDGES.
High Speed Power Traveling Cranes and Hand or Power Swing Cranes, Shafting, Pulleys, Hangers, &c., for transmission of power. Improved Self-Adjusting Injector of 1876. Self-Acting Injector of 1887. Fixed-Nozzle Automatic Injector of 1885.
INJECTORS for ALL CONDITIONS of LOCOMOTIVE and STATIONARY SERVICE.

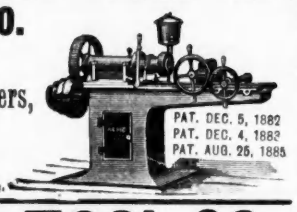


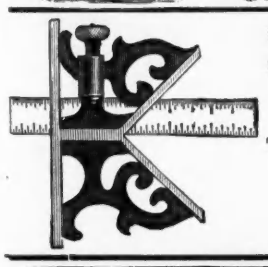
THE LONG & ALLSTATTER CO. Hamilton OHIO.
Double, Single, Angle-Bar, Gang, Horizontal, Twin, Boiler, Spacing, Gate, Multiple, Belt and Steam-Driven
Punches and Shears,
OVER 300 SIZES.
ALSO
Power Cushioned Hammer.
Send for New Catalogue.



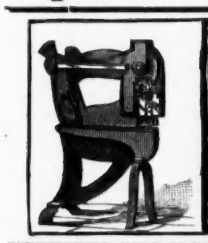


ACME MACHINERY CO.
CLEVELAND, OHIO.
Manufacturers of "ACME"
Single & Double Automatic Boltcutters,
Cutting from 3-8 in. to 6 in. diameter.
Also SEPARATE HEADS and DIES.
Send for Catalogues and Discounts.
FIRST PREMIUM, CINCINNATI CENTENNIAL.

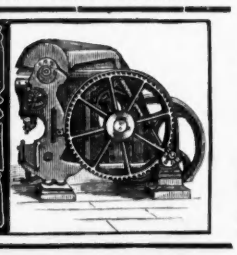




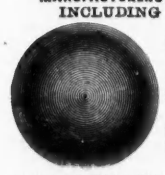
STANDARD TOOL CO.,
ATHOL, MASS.,
MANUFACTURERS OF
The Celebrated Chaplin Try and Center Square, Standard Steel Rules, Steel Caliper Rules, Universal Bevels, Caliper Gauges, Improved Surface Gauges, Bevel Protractors, Depth Gauges, Screw Pitch and Center Gauges, Hardened Steel Squares, Graduated Steel Squares, Spring Calipers, Pliers, Straight Edges, &c., &c.
WRITE FOR ILLUSTRATED CATALOGUE AND PRICE LIST OF FULL LINE.



PUNCHING AND SHEARING MACHINERY
AND BOILER MAKER'S ROLLS.
NEW DOTY MANUFACTURING CO.
JANESVILLE, WISCONSIN.



SIMONDS ROLLING MACHINE CO.,
MANUFACTURERS OF ROLLED FORGED SPECIALTIES,
INCLUDING **STEEL BALLS**



For Anti-Friction Bearings, of Best Cast Steel, Hardened, Ground and Burnished, from 3-16 in. to 2 in. diameter.
In quality and density of metal, in uniformity of temper, and in accuracy and nicety of finish warranted unequaled.
SAMPLES AND PRICES ON APPLICATION.
SIMONDS ROLLING MACHINE CO., Fitchburg, Mass

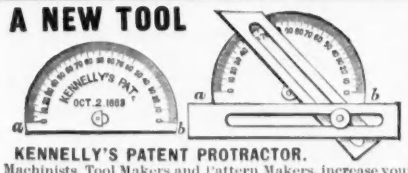
PHOSPHOR-BRONZE INGOTS & CASTINGS
RED & YELLOW BRASS
BABBITT METALS
PAUL S. REEVES
760 S. BROAD ST. PHILA. PA.

IRWIN VEEDER,
Expert and Solicitor of Patents.
SIX years' practical experience in shops after receiving a technical education and before entering the practice.
Rooms 309-11, 225 Dearborn Street, Chicago.
J. H. RAYMOND, OF COUNSEL.

DELAFIELD'S PAT. SAW CLAMP

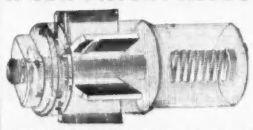
With Saw for Cutting Metals. Saves all the broken hack saw blades. In use over two years, in all parts of the country. The new Clamps have the edges beveled that hold the saw. Free by mail for 50 cents. Extra blades, 1-2 in. wide, 7c. each. 70c. per doz; 1 in. wide, Stubs, 35c. each. Free by mail.
NOROTON MFG. WORKS, NOROTON, CONN.

A NEW TOOL



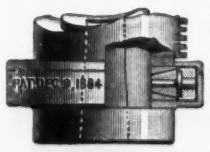
KENNELLY'S PATENT PROTRACTOR.
Machinists, Tool Makers and Pattern Makers, increase your income. Send for Agents' Circular. Agents wanted in every shop. Sent by mail for $1.00. Patented Articles, Special Tools, Jigs, Gauges, etc.
KENNELLY & CAIN,
CRESCENT TOOL WORKS,
Box 1741. Bridgeport, Conn.

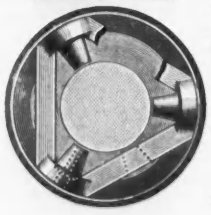
A NEW PATENT ADJUSTABLE REAMER,



thoroughly tested and practical. A set of five will ream any possible size, from 1 3-16 to 4¼ inch.
Send for Circular.
CRANSTON & CO., 57 PARK STREET, N. Y.

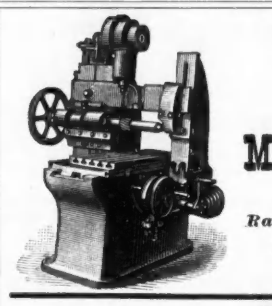
STEEL CASTINGS
From 1-4 TO 15,000 lbs. WEIGHT.
True to pattern, sound, solid, free from blow-holes and of unequaled strength.
Stronger and more durable than iron forgings in any position or for any service whatever.
40,000 CRANK SHAFTS and 30,000 GEAR WHEELS of this steel now running prove this.
Cross-Heads, Rockers, Piston-Heads, etc., for Locomotives.
STEEL CASTINGS of every description.
Send for Circulars and prices to
CHESTER STEEL CASTINGS CO.,
Works, Chester, Pa. Office 407 Library St., Philadelphia, Pa



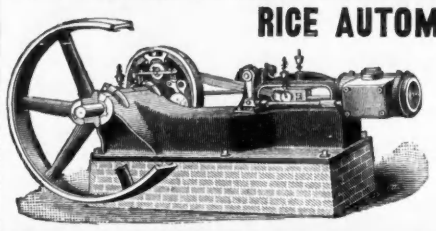


THE **BROWNELL ANTI-FRICTION Step or Thrust Bearing**
FOR
Lathes, Drills, Worm Shafts of Elevators or Hoists, Jack Screws, Mill Stones, Water Wheel and Propeller Shafts.
Bearings of all sizes made to order, and patent rights for sale by
G. L. BROWNELL,
WORCESTER, MASS
Correspondence Solicited.

Improved Methods mean Increased Profits.
INVESTIGATE THE MERITS OF THE
Open Side Iron Planers.
Satisfy yourself as to the very great advantages of these open side machines over the large, costly and cumbersome two-post planers.
And do not lose sight of the fact that they are acknowledged and guaranteed to be equal to the smaller sizes of Planers of the regular style, in the performance of their class of work.
Write for facts, figures and phototypes.
DETRICK & HARVEY, Manufacturers. BALTIMORE, MD.

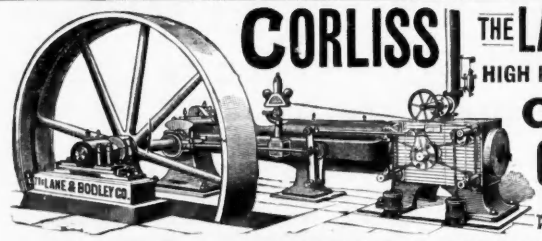


BEMENT, MILES & CO.,
PHILADELPHIA, PA.
—BUILDERS OF—
METAL-WORKING MACHINE TOOLS
FOR
Railroad Shops, Locomotive and Car Builders, Machine Shops, Rolling Mills, Steam Forges, Ship Yards, Boiler Shops, Bridge Works, Etc., Etc.

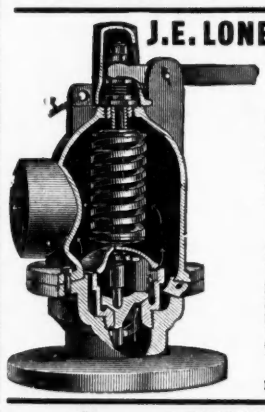


RICE AUTOMATIC CUT-OFF ENGINE.
Self-Contained, Sensitive Governor. Balanced Valve. High Speed. Stationary Oilers. Best Economy.
Gold Medal Cincinnati Exposition, 1884.
THE JOHN T. NOYE MFG. CO.,
BUFFALO, N. Y.

BALL AUTOMATIC CUT-OFF ENGINES,
ERIE, PA.
The characteristics of these Engines are Beauty of Design, Superior Finish, Limited Feet in Space required, Economy of Fuel, Perfection of Regulation.
CHARLES R. VINCENT & CO.,
NEW YORK SELLING OFFICE, 15 CORTLANDT STREET.

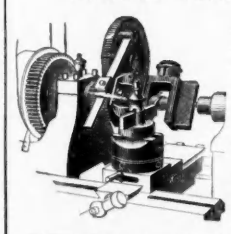


CORLISS | **THE LANE & BODLEY CO.**
HIGH PRESSURE, CONDENSING and
COMPOUND CORLISS ENGINES
AND **STEAM OUTFITS**
THE LANE & BODLEY CO., EAST SIDE JOHN, Corner WATER ST. CINCINNATI, O.

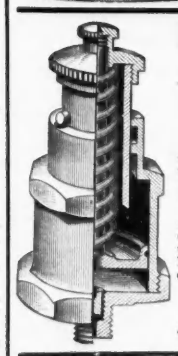


J. E. LONERGAN & CO.
211 Race St., Phila.
Manufacturers of
PATENT OILERS,
Cylinder Sight Feed Cups, Government Regulation
POP SAFETY VALVES
for Locomotive, Stationary and Marine Boilers, also the "Reliable" Steam Trap.
1888 Catalogue free on application.

COATES' PATENT LATHE ATTACHMENT FOR TURNING CROSS-HEAD PINS.



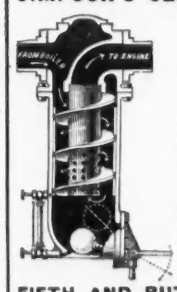
This machine is new and has been thoroughly tested.
Actual tests show a saving of over $10.00 per day over old methods.
Can attach machine to or remove it from any ordinary engine lathe in five minutes.
An ordinary shop, in building engines, will save price of machine in 3 months' time.
An ordinary apprentice can operate machine perfectly well, and turn out first-class work.
Above features guaranteed.
Send for circular and price list.
SALESMEN WANTED. SEND FOR CONTRACT AND BLANK ORDERS.
BAY STATE IRON WORKS,
Licensees and Manufacturers,
ERIE, PA.



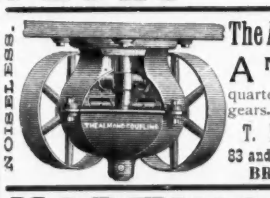
LACKAWANNA GREASE CUP
Will Save its Cost in Oil alone Several Times per Annum.
SAVES ALSO IN LABOR, AND COST OF COTTON-WASTE. PREVENTS DRIPPING AND SPATTERING.
A POSITIVE FORCE FEED, with the most PERFECT REGULATION and GREATEST CONVENIENCE in operation yet attained in any device for the lubrication of machinery. Works equally well in every possible position
Lackawanna Lubricating Co.,
41 Coal Exchange, Scranton, Pa.

LEAKY FLUES
Are unknown where the Reliance Safety Water Columns are used. Every column warranted. Send for illustrated Price List.
Reliance Gauge Co.,
27 Euclid Ave., Cleveland, O.

SIMPSON'S CENTRIFUGAL SEPARATOR AND TRAP.

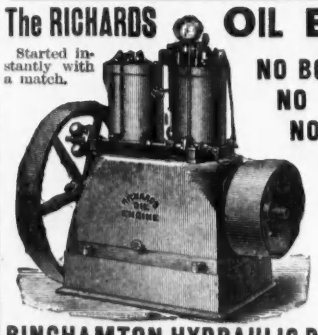


For supplying Clean and Dry Steam to Engines, Dryers, Etc.
Also *Keystone Feed-Water Heaters and Purifiers, Keystone Belt Pumps, Simpson's Centrifugal Exhaust Heads* and other Engineering Specialties. Steam Plants furnished complete and erected. Send for particulars.
KEYSTONE ENGINE AND MACHINE WORKS,
FIFTH AND BUTTONWOOD STS. PHILA.,
Or, ARTHUR APPLETON, Selling Agent, 45 Cortlandt St., N. Y.



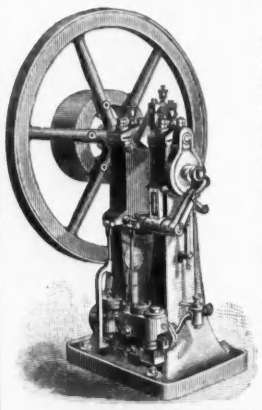
The Almond Coupling
NOISELESS.
A NEW quarter turn motion to replace quarter turn belts and bevel gears.
T. R. ALMOND, MFR.,
83 and 85 Washington Street,
BROOKLYN, N. Y.

The RICHARDS OIL ENGINE.
Started instantly with a match.



NO BOILER.
NO STEAM.
NO DANGER.
Fuel, Crude Petroleum or Kerosene.
Cheaper than all others.
BINGHAMTON HYDRAULIC POWER CO.
BINGHAMTON, N. Y., U. S. A.,
SOLE MANUFACTURERS.

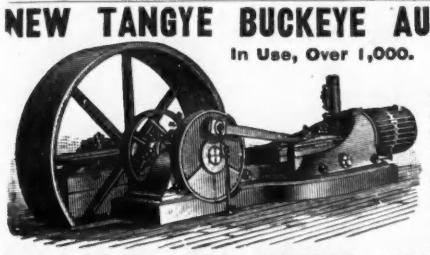
KORTING GAS ENGINE.
1 to 100 Horse Power.



The Korting Gas Engine is placed upon its merits and under full guarantee to every purchaser.
OVER 125 IN USE IN N. Y. CITY.
CATALOGUES on APPLICATION.
KORTING GAS ENGINE CO.,
LIMITED.
429, 431 & 433 Greenwich Street,
Cor. Laight Street, NEW YORK CITY.

NEW TANGYE BUCKEYE AUTOMATIC CUT-OFF ENGINES.

In Use, Over 1,000. 25 to 1,000 H. P.



These engines are the combined result of long experience with automatic cut-off regulation, and most careful revision of all details. They are designed and constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-contained Automatic Cut-off Engines 12 to 100 H.P. for driving Dynamo Machines *a specialty*. Illustrated Circulars, with various data as to practical Steam Engine Construction and performance, free by mail.

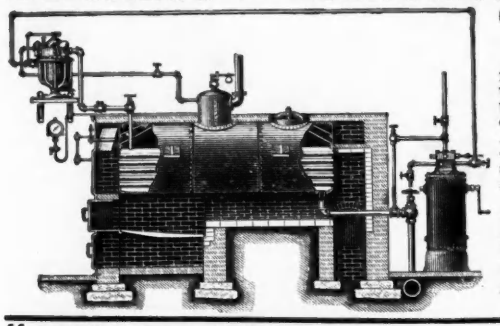
Address, BUCKEYE ENGINE CO., Salem, Ohio.

SALES AGENTS: **W. L. SIMPSON,** 301 TELEPHONE BUILDING, 18 CORTLANDT STREET, N. Y. / N. W. ROBINSON, 154 Washington St., Chicago, Ill. ROBINSON & CARY, St. Paul, Minn.

KENSINGTON ENGINE WORKS, LIMITED, PHILADELPHIA.

Sole Licensees and Manufacturers for New Jersey (South of Trenton), Eastern Pennsylvania, Delaware, Maryland and Virginia.

BLESSING'S WATER CIRCULATOR AND PURIFIER



Guaranteed to Absolutely Prevent Formation of Scale in Steam Boilers.

Automatically takes water from the boiler, filters, it and returns it in pure condition, thus removing scale-making impurities from the water, and maintaining a free and steady circulation. Combines the well-known Albany Steam Trap with a Filter of novel construction, which has no rival in point of simplicity, facility for cleaning, and assurance against clogging of sand valve.

Send also for Circulars of Albany Steam Traps, Blessing's Renewable-Seat Stop and Check Valves, Pump Governors, Water Circulators and Purifiers, etc.

Albany Steam Trap Co., ALBANY, N.Y.

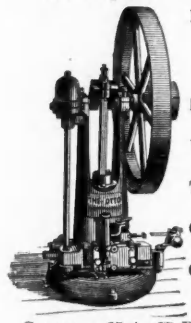
"OTTO" GAS ENGINE WORKS.

SCHLEICHER, SCHUMM & CO.,

33d & Walnut Streets, Philadelphia. 130 Washington Street, Chicago.

New York Agency, 18 Vesey St.

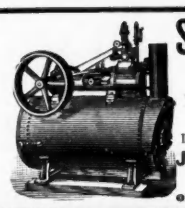
OVER 25,000 ENGINES SOLD.



HORIZONTAL "Otto" Gas Engines.
VERTICAL "Otto" Gas Engines.
TWIN CYLINDER "Otto" Gas Engines.
COMBINED "OTTO" GAS ENGINES AND PUMPS.
COMBINED "OTTO" GAS ENGINES AND DYNAMOS.

Consume 25 to 75 Per Cent. Less Gas than ANY other Gas Engine doing the same work.

STEAM ENGINES



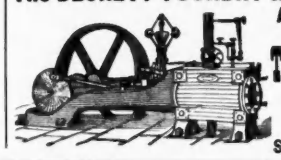
Upright and Horizontal, Stationary, Portable and Semi-Portable.
8 to 16 Horse Power.
Illustrated Pamphlet Free. Address
JAMES LEFFEL & CO SPRINGFIELD, OHIO, or 110 Liberty St., New York.

PATENTS

THOMAS P. SIMPSON, Washington, D. C. No atty's fee until Patent obtained. Write for Inventor's Guide.

The BECKETT FOUNDRY & MACHINE CO.,

ARLINGTON, N. J.
Manufacturers of



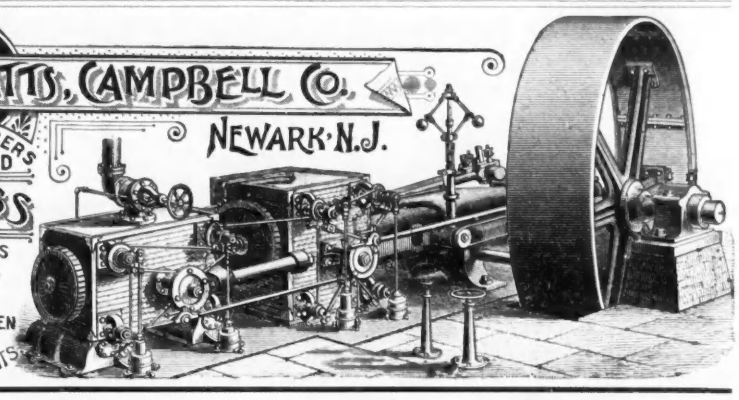
The "MUNZER" Corliss Engine.
Send for Catalogue

THE WATTS, CAMPBELL CO.

NEWARK, N.J.

MANUFACTURERS OF IMPROVED CORLISS STEAM ENGINES IN FULL VARIETY.

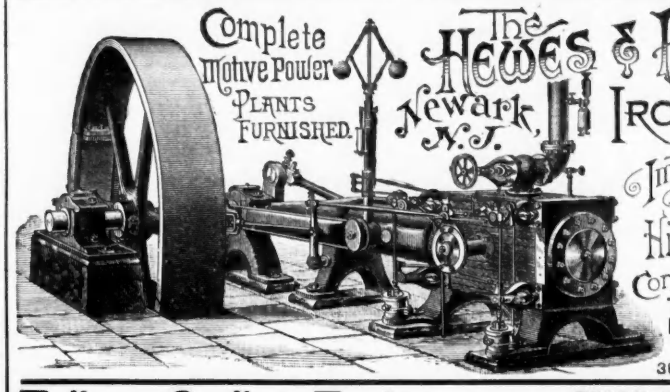
CONTRACTS TAKEN FOR COMPLETE POWER PLANTS.



The HEWES & PHILLIPS IRON WORKS

Newark, N.J.

Complete Motive Power Plants Furnished.



Improved CORLISS ENGINES, High Pressure, Condensing and Compound

TUBULAR BOILERS.
HEAVY FLY WHEELS A SPECIALTY.
IN SIZES UP TO 36 FT. DIA. BY 10 FT. FACE.

Eclipse Corliss Engine.

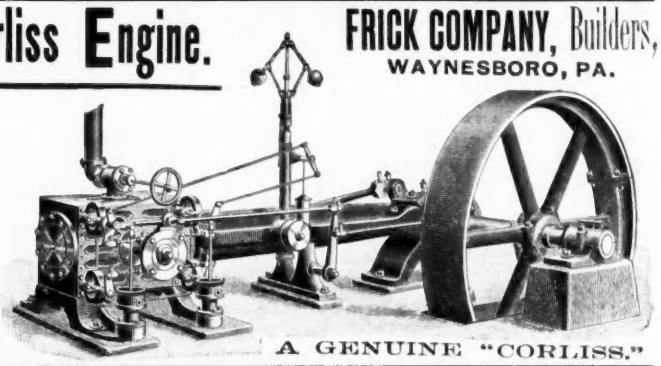
FRICK COMPANY, Builders,
WAYNESBORO, PA.

NON-CONDENSING, CONDENSING COMPOUND.
40 TO 1,000 H.P.

Send for Circulars.

E. P. HAMPSON & CO., 36 CORTLANDT ST., NEW YORK, Sole Eastern Agents.

JOHN J. METZGER, 69 S. Clinton St., Chicago, WESTERN AGENT.

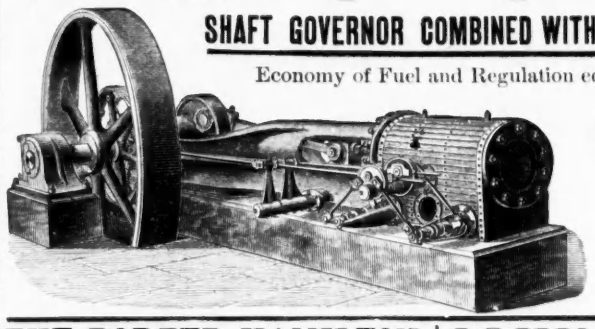


A GENUINE "CORLISS."

PAYNE HIGH SPEED CORLISS ENGINE.

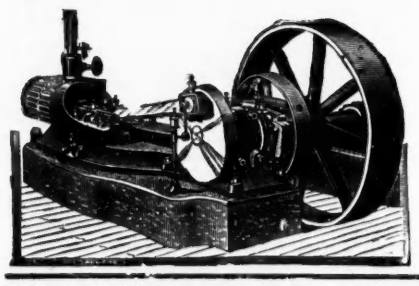
SHAFT GOVERNOR COMBINED WITH CORLISS WRIST-PLATE.

Economy of Fuel and Regulation equal to anything in use.



B. W. PAYNE & SONS,
ELMIRA, N. Y.
45 Dey St., New York.
Hill, Clarke & Co.,
Boston, Mass.
10 S. Canal St., Chicago, Ill.

Russell & Co.



MASSILLON, OHIO,
BUILDERS OF
AUTOMATIC ENGINES
BOILERS, ETC.
Complete Power Plants Furnished and Erected.
SEND FOR CATALOGUE.

RATCHETS, WRENCHES, DRILLS.

LOWELL WRENCH CO., WORCESTER, - - MASS.

PECK'S PAT. DROP PRESS.

NEW HAVEN BEECHER & PECK, CONN.

DROP FORGINGS OF IRON OR STEEL

BEECHER & PECK, NEW HAVEN CONN.

FOR SUBSTANTIAL, WELL MADE, LOW PRICED

20 INCH DRILLS,

With latest improvements, Lever or Wheel feed, address
Sibley & Ware,
SOUTH BEND INDIANA.

NORTH WESTERN BUYERS.

We will open on or about March 1st, 1889, at corner Lake and Canal Sts, **Chicago,** a depot for the exhibition and sale of our Improved Engine Lathes, Monitor, and Turret Chucking Lathes, Iron Planers, Shapers, Upright Drill Presses, etc.

☞ Automatic Stop on Engine Lathes.

☞ Automatic Stop on Drill Presses.

☞ No charge for extra attachments.

LODGE, DAVIS & CO.

Lake & Canal Streets,
CHICAGO.
WORKS, Cincinnati, Ohio.

☞ See Advertisement, Page 16.

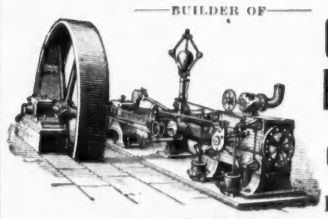
THE PORTER-HAMILTON,

The best Engine in America for Heavy Work.
WILLIAM TOD & CO.,
Youngstown, Ohio.

VOLNEY W. MASON & CO.,
Friction Pulleys, Clutches and Elevators,
PROVIDENCE, R. I.

JOHN McLAREN,

BUILDER OF



CORLISS Engines, AIR Compressors and BOILERS.
HOBOKEN, N. J.

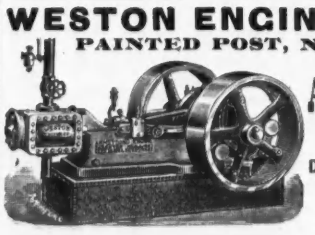
STEARNS M'F'G CO.

ERIE, PA.

ENGINES from 15 to 400 Horse Power
Boilers of Steel and Iron supplied to the trade or the user. Send for Catalogue.
SAW MILLS AND GENERAL MACHINERY
NEW YORK STORE, 46 Cortlandt St.

WESTON ENGINE CO.

PAINTED POST, N. Y.



THE ARMSTRONG ENGINE.
CORRECT IN Design, Workmanship and Price.
5 to 75 H. P.

MACHINERY ON HAND.

16 in. x 42 in.	Planer.	Bridgeport,	new
20 in. x 5 ft.	"	P. & W.,	good.
23 in. x 5 ft.	"	Hendey,	new.
22 in. x 5 ft.	"	Powell,	"
24 in. x 6 ft.	"	Powell,	"
30 in. x 8 ft.	" each	Atherton, Powell & H. & P.	new.
6-8-10-12-15 in Crank Shapers.			
15x20 in. Friction Shapers.			
20-24-26 and 32 in. Geared Shapers.			
12 in. x 5 1-2 ft. Engine Lathe,		S. M. & Co.	new.
12 in. x 6 ft.	"	Young,	"
13 in. x 6 ft.	"	Ames,	"
14 in. x 6 ft.	"	Blaisdell,	"
14 in. x 7 ft.	"	Bogart,	"
14 in. x 8 ft.	" Gap Bed,	S. M. & Co.,	"
15 in. x 6 and 8 ft.	"	Porter,	"
16 in x 6 and 8 ft.	"	Blaisdell,	"
16-20 in. x 6-8-10 & 12 ft.		Bridgeport,	"
18 in. x 8-10-12 ft.	"	Different Makes,	"
20 in. x 8-10-14 ft.	"	Different Makes,	"
20 in. any length Bed	"	Bridgeport,	"
22 in. x 12 ft.	"	Niles,	heavy, good.
23 in. x 8-10-12	"	Bridgeport,	new.
28 in. x 14-16 & 18ft. Engine Lathes,		T. & S.	"
20 in. Drill		Davis,	"
20-23-25-28 inch Drills		Blaisdell,	"
20-25-28-32 inch	"	C. & S.	"
5 ft. Arm Universal Radial Drill,			"
Cabinet Turret Lathe, Lodge, Davis & Co.			"
No. 2 4 Screw Machine, Brown & Sharpe.			"
Ames Index Milling Machine,			fair.
No. 2 Garvin Hand Miller,			A 1.
No. 5 Brainard "			A 1.
Lincoln Pattern,	"		good order.
No. 1 and 3 Universal Miller, Brown & Sharpe,			new.
No. 2 Plain " " " "			fair order.
No. 3 Surface Grinder,	"	"	A 1.

Cold Rolled Shafting in Stock. Send for list. Write for what is wanted.

E. P. BULLARD,
62 COLLEGE PLACE & 72 WARREN ST.,
NEW YORK.

List of Second-Hand MACHINERY

TAKEN IN TRADE FOR NEW.

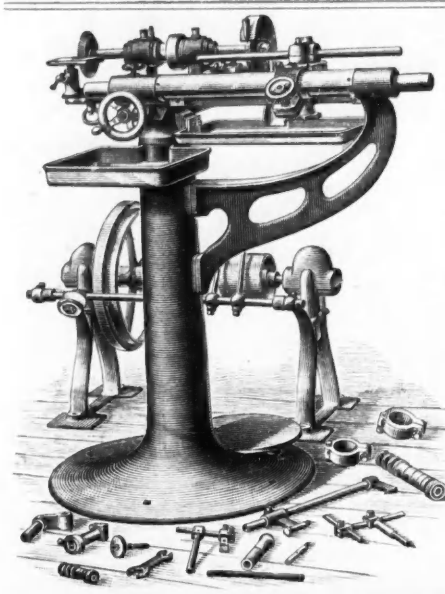
10" x 5' Engine Lathe,	F. E. Reed.
12" x 5' Engine Lathe,	Prentice, (new).
15" x 6' Engine Lathe,	Lathe & Morse.
16" x 6' Engine Lathe,	Powell.
16" x 6' Engine Lathe,	Blaisdell.
16" x 11' Engine Lathe,	New Haven.
20" x 8' Engine Lathe,	Powell.
21" x 10' Engine Lathe,	Lathe & Morse, (new).
26" x 10' Engine Lathe,	Putnam Machine Co.
Cabinet Turret Lathe,	Lodge, Davis & Co. (new).
16" x 16" x 3' Planer,	Lathe & Morse.
24" x 24" x 6' Planer,	Chamberlin.
26" x 26" x 6' Planer,	Hendey.
30" x 30" x 8' Planer,	Bement.
36" x 36" x 10' Planer,	Whitcomb, (new).
42" x 42" x 10' Planer,	William Gleason.
15" Stroke Shaper,	Hendey.
20" Upright Drill,	Prentice.
22" Upright Drill,	Reed.

Above 2d-hand tools are in first-class condition. Write for list giving prices and descriptions.

We also carry much the largest stock of New Machine Tools in the country.

HILL, CLARKE & CO.

156 OLIVER STREET,
BOSTON, MASS.



Brown & Sharpe Mfg. Co.

PROVIDENCE, R. I.

No. 3 UNIVERSAL CUTTER AND REAMER GRINDER.

Patented Nov. 3, 1885; *March* 22, 1887.

THIS machine is extensively used for sharpening straight or taper, shell or shank reamers, and for grinding edge and bevel cutters of any angle, straddle and face mills, cotter and hollow mills, and straight or taper milling cutters, cut either straight or spiral, with holes or shanks. It can also be used for sharpening worm or thread tools. All moving parts are adjustable. Movements quick and accurate, simple and mechanical. Spindle has two speeds. Distance between centers, 12″. Mills or shell reamers 6″ diameter and not over 6″ long can be satisfactorily ground. Emery wheels used up to 7″ diameter, either with or without water.

Special Pamphlet mailed on application.

WESTERN AGENT,
S. A. SMITH, 23 S. Canal St., Chicago, Ill.

THE PRATT & WHITNEY CO.,

HARTFORD, CONN.,

Manufacture Gardner & Woodbridge patent and new Threading Tool, Rhodes' Square Thread Tool, Woodbridge Lathe and Planer Tool, Johnson's Cutting-off Tool, Kidd's Improved Dividers and Adjustable Caliper Gauges.

WESTERN BRANCH, 100 West Washington Street, Chicago, Ills.

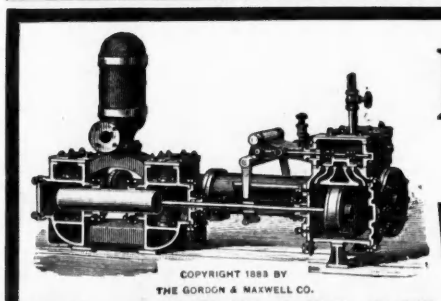
THE BILLINGS & SPENCER CO.

HARTFORD, CONN. U.S.A.

MANUFACTURERS OF BILLINGS' DROP FORGED LATHE DOGS FORGED FROM BEST STEEL FOR THE PURPOSE

IN 12 SIZES 3/8 UP TO AND INCLUDING 4 IN. ALSO CLAMP AND DIE DOGS

DROP FORGINGS OF COPPER, IRON AND STEEL OF ALL DESCRIPTIONS



COPYRIGHT 1888 BY THE GORDON & MAXWELL CO.

Duplex Steam Pumps AND Water Works Machinery.

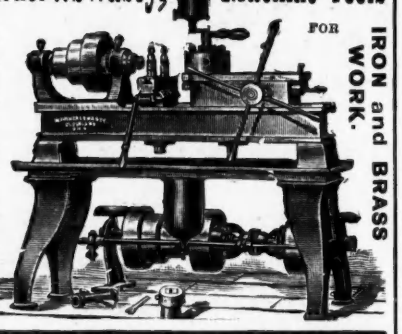
THE GORDON STEAM PUMP CO.

HAMILTON, OHIO.

BRANCH HOUSES:

NEW YORK, 96 Liberty Street.
PHILADELPHIA, 705 Arch Street.
CHICAGO, 96 Lake Street.

Warner & Swasey, Machine Tools FOR IRON and BRASS WORK.



CLEVELAND, OHIO. ILLUSTRATED CATALOGUE ON APPLICATION.

REMOVAL.

THE POND MACHINE TOOL COMPANY,

Formerly of Worcester, Mass.

The new shops of this company are located at Plainfield, N. J., forty minutes' ride from New York city on the line of the Central Railroad of N. J., and consist of the following:

A machine shop 500′ long by 100′ wide; a foundry 250′ long by 90′ wide; also commodious buildings for the storage of sand, coal, coke and pig iron; ample and convenient wash rooms for the men; fireproof two story pattern storage; blacksmith shop; engine and boiler houses. These buildings are detached from the machine shop and foundry. There is an elevated railroad for the convenient distribution of raw materials, and a railroad running through the machine shop for shipping. The whole plant is supplied with the incandescent system of electric lighting.

The machine shop and foundry have overhead traveling cranes running through their entire lengths; also light traveling cranes, which serve every tool, and a number of jib cranes in the foundry and scratch rooms. The foundry has capacity for making the heaviest class of castings.

All our tools are expressly designed for the economical manufacture of heavy machinery for railroad and general machine shop equipment, from new patterns of the latest and best designs.

SALESROOM and OFFICE, 111 & 113 Liberty St., N. Y. City.
NEW SHOPS, Plainfield, N. J.

CRANES

THE YALE & TOWNE MFG CO.
STAMFORD CONN
NEW YORK CHICAGO PHILA. BOSTON

JENKINS BROS. VALVES.

THE ENDORSEMENT OF FIRST-CLASS ENGINEERS AND MECHANICS THROUGHOUT THE COUNTRY has fully demonstrated these valves to possess the following advantages over all other valves now in use:

1.—A perfectly tight valve under any and *all pressures of steam, oils, or gases.* 2.—Sand or grit of any kind will not injure the seat. 3.—You do not have to take them off to repair them. 4.—They can be repaired by any mechanic in a few minutes. 5.—The elasticity of the Disc allows it to adapt itself to an imperfect surface.

In Valves having ground or Metal seats, should sand or grit get upon the seat, it is impossible to make them tight, except by regrinding, which is expensive if done by hand, and if done by machine soon wears out the valve, and in most cases they have to be disconnected from the pipes, often costing more than a new valve. The Jenkins Discs used in these valves are manufactured under our 1880 patent, and will *stand any pressure of steam, oils, or acids.*

JENKINS BROS., 71 John St., N. Y.; 105 Milk St., Boston; 21 North Fifth St., Phila.; 54 Dearborn St., Chicago.

GEO. W. FIFIELD,

MANUFACTURER OF

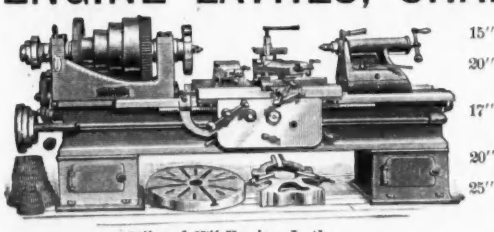
ENGINE LATHES

FROM 16 to 48 IN. SWING.

Cuts, Photographs and Prices furnished on application.

Lowell, Mass., U. S. A.

ENGINE LATHES, SHAPERS & DRILLS.



24″ and 27″ Engine Lathe.

15″ and 20″ Crank Shapers.
20″ 26″ and 32″ Geared Shapers.
17″ 19″ 21″ 24″ 27″ and 38″ Engine Lathes.
20″ 24″ Upright Drills.
25″ 28″ 32″ 40″ B. G. P. F. Drills.

25-INCH BACK GEARED AND POWER FEED DRILL.

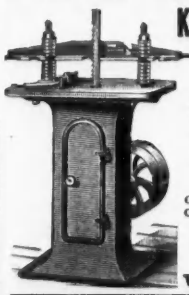
LODGE, DAVIS & CO.,

CINCINNATI, OHIO.

SEND FOR PRICES. IT WILL PAY YOU.

See advertisement, page 15.

Gear Wheels and Gear Cutting.—I make g to order, or cut teeth on g blanks sent to me. Of all kinds. Of all sizes to six ft. dm. Small orders or large ones. Fine g or cheap g. Small cast g. Ready made brass g by mail at low prices. Bevel g with perfect planed teeth. Hand Book on g, $1. Facilities complete. Terms reasonable. Send for cat.
GEO. B. GRANT, 66 Beverly St., Boston, Mass.



Key-Seating Machines and 20 in. Drills

A SPECIALTY.
SEND FOR LIST OF
New and Second-Hand
Lathes, Planers, Drills, or anything in Machinists' Tools or Supplies.

W. P. DAVIS,
Rochester, N. Y.
Works at North Bloomfield.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.

HARTFORD, CONN.

J. M. ALLEN, PRESIDENT.
WM. B. FRANKLIN, VICE-PRESIDENT.
F. B. ALLEN, SECOND VICE-PRESIDENT.
J. B. PIERCE, SECRETARY & TREASURER.

PATENT UNIVERSAL SCREW-CUTTING CENTER DEPTH ANGLE AND **TWIST DRILL GAUGE.**
J. WYKE & CO.,
Fine Machinists' Tools.—**E. Boston, Mass.**—Send for Circular

E. GOULD & EBERHARDT

NEWARK, N. J.

Eberhardt's Patent
AUTOMATIC GEAR CUTTER.
18 in. 25 in. 36 in. 50 in 60 in. 84 in. Sizes.

"Experts pronounced it the best."

GEAR AND RACK CUTTING TO ORDER

E. E. GARVIN & CO.

139 & 141 CENTRE STREET, NEW YORK.
Manufacturers of
MACHINISTS' TOOLS
SMALL AUTOMATIC MILLER, WITH ARM.

The Machine shown in cut is designed for rapid and convenient milling of small work.

Send for Catalogue.

NEW CATALOGUE MACHINE TOOLS.

THE G. A. GRAY CO.,
477-481 SYCAMORE ST., CINCINNATI, O.
See advertisement, page 13.

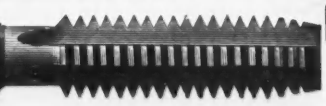
STEEL CASTINGS.

PRATT & LETCHWORTH,
PROPRIETORS
BUFFALO STEEL FOUNDRY,
BUFFALO, N. Y.

The STILES PATENT DROP HAMMER,

Manufactured by
THE STILES & PARKER PRESS CO.,
MIDDLETOWN, CONN.
ALSO MAKERS OF
PUNCHING STAMPING DRAWING **PRESSES** and DIES.
Branch Office and Factory, 203, 205 & 207 CENTRE ST.,
200 p. Catalogue on application. NEW YORK CITY.

J. M. CARPENTER
PAWTUCKET, R. I.



Manufacturer —of— TAPS & DIES